SYNTHETIC FUELS ENVIRONMENTAL RESEARCH AND DEVELOPMENT

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

AND THE

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

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*On assignment to Budget Committee for the 97th Congress.

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SYNTHETIC FUELS ENVIRONMENTAL RESEARCH AND DEVELOPMENT

THURSDAY, OCTOBER 1, 1981

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS AND THE SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE RESEARCH AND ENVIRONMENT,
Washington, D.C.

The subcommittees met, pursuant to notice, at 2:15 p.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the Subcommittee on Energy Development and Applications) and James H. Scheuer (chairman of the Subcommittee on Natural Resources, Agriculture Research and Environment) presiding.

Present: Representatives Fuqua, Weber, Skeen, Schneider, and Dunn, Subcommittee on Energy Development and Applications; and Representatives Scheuer, Carney, and Sensenbrenner, Subcommittee on Natural Resources, Agriculture Research and Environment.

Staff present: Dr. Martha Krebs, staff director, and Bill Harvey, minority staff assistant, Subcommittee on Energy Development and Applications; and Tony Clark, staff assistant, Subcommittee on Natural Resources, Agriculture Research and Environment.

Mr. FUQUA. The joint hearing will begin.

The recent commitments of financial assistance by the Department of Energy to three synthetic fuels projects are an intermediate but long-awaited step toward an American synthetic fuels industry.

The Science Committee has supported and encouraged these projects, and I am personally pleased that something is actually getting done.

In addition to recognizing the vital role that synthetic fuels will play for our country's energy security, the committee has always had a deep concern that these industries meet all environmental requirements. However, legislated requirements may only be half the story.

Many process streams in synthetic fuels plants may contain carcinogenic or mutagenic substances. Much remains unknown about the effect of these substances and even more needs to be learned about process improvements at the plant site that may minimize the presence of these hazardous materials.

Today we want to hear about the kinds of environmental research that industry is doing, what sorts of measures are being

taken to protect and monitor worker health, and what industry sees as the major environmental unknowns in synthetic fuels process development.

We also will inquire more broadly about the benefits and limitations of Federal R. & D. programs in the Department of Energy and the Environmental Protection Agency. We need to know more clearly how these programs can be improved and better-targeted for the benefit of both the public health and welfare and the growing synthetic fuels industry.

We are pleased to welcome our witnesses.

In the first panel, we will receive testimony from Dr. Carleton B. Scott from the Union Oil Co., and Mr. Roger D. Chittum of the Tosco Corp.

The second panel includes Dr. Michael J. Massey of Environmental Research & Technology, Inc.; Dr. Richard D. Brown of MITRE Corp.; and Dr. Michael J. Chartock of the University of Oklahoma.

At this time I would like to ask the co-chairman of the hearing, the Honorable Jim Scheuer from New York, who is chairman of the Subcommittee on Natural Resources, Agricultural Research and Environment, if he has a statement to make.

Mr. SCHEUER. Thank you very much, Mr. Chairman.

I want to congratulate you for your leadership in arranging these hearings, and I wholeheartedly agree with your comments.

I firmly support the synfuel programs and have since they first became an issue here in Congress.

I had the privilege of visiting one of the great synfuels installations in the world, the SASOL plant in South Africa, and observed how well it worked and how nonexistent the environmental fallout seemed to be.

It is perfectly clear that if we are in the midst of a national push to rid ourselves of our utterly shameless dependency on Persian Gulf oil, we must find alternative sources of oil. We must look within ourselves in our own country to see what alternatives we can produce.

We cannot do that, however, without concern for the effect on our environment and the national health. These are also important matters.

It is perfectly clear that the increased use of coal and oil shale can—not necessarily must—threaten both our environment and our health.

One perfect example, both of the enormity of the problem and the difficulty of the problem, is the problem of acid rain, which has devastated the over 200 lakes in the Adirondacks region in my State. It has harmed lakes, rivers, forests, and croplands all over the eastern seaboard and has had a devastating effect on the Canadian environment and economy.

Fifteen percent of their GNP is produced by forest products. They feel that harm to forest growth may be as much as 15 percent a year from the heavy fall of acid rain.

I would ask unanimous consent to insert my remarks at this point in the record. I know that we have a busy day ahead of us, but I feel that we can learn a great deal in this hearing today that will help us in our consideration of the synfuels program.

Again, I congratulate you on your fine leadership which has brought us to this hearing.

Mr. FUQUA. Thank you, Mr. Scheuer.

Without objection your remarks will be included in the record.

[The opening statement of Mr. Scheuer follows:]

OPENING STATEMENT
HON. JAMES H. SCHEUER
HEARING ON SYNTHETIC FUELS ENVIRONMENTAL
RESEARCH AND DEVELOPMENT
OCTOBER 1, 1981

THANK YOU, MR. CHAIRMAN.

I WHOLEHEARTEDLY AGREE WITH YOUR COMMENTS AND I CONGRATULATE YOU FOR HOLDING THIS JOINT HEARING ON A MATTER OF GREAT CONCERN TO ME.

AT THE OUTSET, LET ME SAY THAT I FIRMLY SUPPORT ENERGY DEVELOPMENT EFFORTS, SUCH AS SYNFUELS, THAT MAKE USE OF THE VAST COAL AND OIL SHALE RESOURCES AVAILABLE IN THIS COUNTRY.

IF WE ARE TO RID OURSELVES OF THE CHOKING DEPENDENCE ON FOREIGN OIL AND EASE WORLD DEMAND FOR OIL, THEN WE MUST MOVE AGGRESSIVELY FORWARD TO DEVELOP ALTERNATIVE ENERGY RESOURCES THAT EXIST IN THE UNITED STATES.

WE MUST, HOWEVER, GIVE EQUAL ATTENTION TO THE ENVIRONMENTAL

CONSEQUENCES OF THIS CRASH PROGRAM BECAUSE THE NEED TO PROTECT PUBLIC HEALTH AND THE ENVIRONMENT IS JUST AS GREAT AS OUR NEED FOR ALTERNATIVE SOURCES OF ENERGY.

I WOULD LIKE TO POINT TO ACID RAIN AS AN EXAMPLE OF AN ENVIRONMENTAL PROBLEM THAT MAY BE EXACERBATED BY THE INCREASED USE OF COAL AND OIL SHALE.

ACID RAIN THREATENS TO CAUSE GREAT DAMAGE, BEYOND WHAT HAS ALREADY BEEN EXPERIENCE, IN MY OWN STATE AND IN OTHER STATES AND COUNTRIES SUCH AS CANADA.

SULFUR OXIDE EMISSIONS HAVE BEEN PROPORTED TO BE A MAJOR CAUSE OF ACID RAIN AND I WOULD VIEW WITH DISFAVOR AN INCREASE IN THESE EMISSIONS AS A RESULT OF SYNFUEL PLANT OPERATIONS AND THE BURNING OF FUELS PRODUCED BY THESE PLANTS.

I AM EQUALLY CONCERNED ABOUT OTHER HARMFUL POLLUTANTS ASSOCIATED WITH THE SYNFUELS INDUSTRY, SOME OF WHICH ARE KNOWN TO BE EXTREMELY HAZARDOUS AND SOME THAT HAVE YET TO BE DISCOVERED.

AS THE COMMITTEE WITH JURISDICTION OVER ENERGY AND ENVIRONMENTAL RESEARCH, WE HAVE A RESPONSIBILITY TO MAKE SURE THAT EVERY EFFORT IS MADE, BOTH BY PRIVATE INDUSTRY AND THE PUBLIC SECTOR, TO ENSURE THAT SYNFUELS DEVELOPMENT PROCEEDS IN AN ENVIRONMENTALLY ACCEPTABLE MANNER.

WHAT WE LEARN FROM THIS HEARING WILL HELP US IN THIS EFFORT AND I LOOK FORWARD, WITH GREAT INTEREST, TO THE TESTIMONY WE ARE ABOUT TO RECEIVE.

AGAIN, I CONGRATULATE MY DISTINGUISHED COLLEAGUE FROM FLORIDA FOR LEADERSHIP IN THIS IMPORTANT UNDERTAKING.

THANK YOU, MR. CHAIRMAN.

Mr. FUQUA. Mr. Carney, the ranking minority member, do you have a statement?

Mr. CARNEY. Thank you, Mr. Chairman.

Our hearings today are very timely.

This committee has seen its support for the conversion of coal and extraction of shale oil expand to a developing synthetic fuels industry. Three projects have recently become on-going contracts at the DOE—two on oil shale and one for coal gasification.

Also, the Synthetic Fuels Corporation is evaluating 63 proposals for the production of a wide variety of synthetic fuels.

We understand that some of these proposals could become active projects in the next 6 months, so all major issues in the synthetic fuels industry should be addressed now to prevent any program holdups in the next few years.

Mr. Chairman, it is my concern that although we are going to commercial scale with processes which appear to be technically sound, questions have been raised about certain environmental features of those processes.

I believe my colleague from New York State, the chairman of our subcommittee, Mr. Scheuer, in his opening statement mentioned some of the problems associated with acid rain.

We have an understanding of the problems associated with some emissions, such as SO_2 in particular and waste streams which are presently subject to national and some local regulations.

However, testimony received by the committee earlier this year stresses the need to investigate other chemicals found in process streams which are considered to be harmful.

Apparently, we do not know what quantities of these chemicals can be expected, and we do not know what amounts of exposure to these chemicals are acceptable. We are told that research and development is needed to answer these unknowns.

Today our witnesses should be able to tell us what work the private and Federal sectors are doing on environmental issues for the synthetic fuels industry. We also expect to hear about the amount and kind of work which should be performed beyond present efforts.

Failure to adequately address these concerns could seriously delay the growth of the industry. The outcome would be to prolong our national dependency on national foreign oil sources and to continue exporting huge sums of money for that oil.

Mr. Chairman, I am certain that our witnesses will provide definite assistance to this committee.

Thank you, Mr. Chairman.

Mr. FUQUA. Thank you, Mr. Carney.

Our first panel is Dr. Scott and Mr. Chittum. We will be happy to hear from you now.

Dr. Scott, we will begin with you.

Your entire written submissions will be made a part of the hearing record at the completion of the oral presentations of each panel.

STATEMENT OF DR. CARLETON B. SCOTT, DIRECTOR, ENVIRONMENTAL SCIENCES DEPARTMENT, UNION OIL CO. OF CALIFORNIA, LOS ANGELES, CALIF.

Dr. SCOTT. Thank you, Mr. Chairman.

My name is Carleton Scott, and I am director of the corporate environmental sciences department of Union Oil Co. of California.

I am certainly pleased to be here this afternoon and to try to respond to your issues.

Let me touch very briefly on Union's shale project.

As you may well know, we currently are under construction on a 12,500-ton-per-day room and pillar mine, an above-ground shale retort, and a shale oil upgrading facility that will produce some 100,000 barrels per day of low-sulfur, low-nitrogen synthetic crude oil.

The startup of this facility is scheduled for mid-1983. Our current plans are to operate this phase I facility for several months, and then to begin phase II development to produce an additional 40,000 to 90,000 barrels of syncrude per day.

Our shale resources are calculated to be some 1.6 billion barrels of recoverable oil, and we calculate that would support a 100,000-barrel-per-day level of operation for nearly 45 years.

Attached to my statement as exhibit I is a rather lengthy position statement describing in much more detail the aspects of this project and some of the social and socioeconomic protection steps.

Turning now to the questions that were raised in your letter of invitation about the nature and adequacy of environmental research and development, the environmental problems that may be encountered in the future, and the need for additional environmental research and development, I will answer these from the perspective of a company that has been doing shale research and development for some 40 years.

The first question that we identified in your letter is: Are current environmental controls adequate?

As you pointed out in the opening comments, we understand that concerns have been expressed over the possibility of new environmental or health risks resulting from production and use of shale oil.

Those of us who work on a day-to-day basis with the legislative and regulatory controls covering shale believe that these concerns have very little basis in actual fact.

The 21 major Federal laws covering shale are listed in exhibit II of my statement.

When one combines these Federal laws with the related States laws and the associated regulations connected with all of them—those regulations as you well know ranging from a few score pages to several hundred pages for each law—we find it difficult to believe there is any credible area where an environmental or health loophole may exist.

We believe that shale projects and products are exceptionally well-covered by existing environmental and health laws and regulations. We can see no justifiable opportunities for additional regulation.

The next question that we identified was: What are the current environmental and health protection steps?

The concern is that the risks may be greater with shale because the industry is so new that all possible regulations have not been put in place.

Again, that was touched on in your opening comments.

Essentially all of the environmental laws that are listed in exhibit II to my statement are implemented through some sort of permit system. In the case of our 10,000-barrel-per-day project, the 43 environmental permits are listed in exhibit III.

I think it is important to point out that most of these permits have very specific environmental controls, standards, and conditions that must be met. Additional permits will be required for any modifications or expansions to this initial phase I project.

In addition to these controls, standards, and conditions that must be met through the permitting procedures, provisions of the Federal Toxic Substances Control Act require consideration of three important points:

First, the toxicities of shale products; second, the risks that may be encountered in producing, marketing, and using these products; and, third, the best means of minimizing those risks.

This work currently is underway, both within our own company and within toxicological laboratories that have been engaged by our company.

Preliminary contact has been made with EPA on this program, and we expect to maintain a very close working relationship with EPA as this toxicological work moves ahead.

Our primary objectives in this work are threefold: First, to be sure that we meet both the letter and the spirit of the law; second, that we fully understand any unusual risks that may exist; and, third, that we fully protect our employees, our neighbors, and the general public from any such unusual risks.

We believe it is clear that an extraordinary network of regulations already covers the shale industry. The concerns over inadequate coverage simply, again, are without any basis in fact.

The next question we were able to identify is: How will environmental and health protection steps be monitored?

Again, questions have been raised about the effectiveness of these steps, particularly if these steps will be rigidly implemented.

We see the implementation being achieved through three basic mechanisms. The first, of course, is the obvious enforcement by the agencies. Traditionally, enforcement of these laws and regulations was through the Federal, State, and local levels. Both monetary and personal penalties for any violations are very severe. I believe it is safe to say that most enforcees take agency enforcement very seriously indeed.

The second point is enforcement by the company. As you may know, internal company compliance reviews or audits are becoming more elaborate and more formalized. I am very pleased to say that Union has recently brought on-stream an internal environmental and health compliance review program that will continuously monitor the compliance status of the entire corporation.

The primary objective of this program is, first, to assist facility managers in knowing about and complying with the multitude of

regulatory requirements and, second, in locating and correcting any soft spots in compliance at the earliest possible stage.

We believe this program will develop into a very powerful tool for assuring continuous implementation of regulatory requirements.

The third implementing mechanism is the monitoring required under the Energy Security Act. A very extensive monitoring program will be implemented by Union under conditions of the contract between Union and the United States which has been executed under the Energy Security Act.

Details of this program, which are defined in exhibit IV attached to my statement, cover basically seven areas.

First is the mine and retort, second the shale oil upgrading facility, third the waste rock and spent shale reclamation procedures, fourth the socioeconomic commitments and obligations, fifth the occupational exposure conditions of workers, sixth the implementation of safety procedures, and seventh the monitoring of worker health.

The combination of these three mechanisms I have been talking about for assuring implementation of regulatory requirements is elaborate and unique. There can be little doubt about the effectiveness of the environmental and health protection steps.

The next question that we identified in your letter was how much environmental research and development has been done—particularly, what has been its extent and adequacy insofar as shale is concerned.

The scientific literature covering such research is substantial, and I certainly will not take any time now to summarize that work in this statement.

Perhaps the most productive way to address this issue is just to focus on the kinds of environmental research that Union has conducted since beginning shale work in the 1940's.

The initial environmental research was aimed at catalytic processes for removing potential pollutants, particularly sulphur, nitrogen, and smoke-forming molecules, from the shale oil products. This work has continued over the years. It has been extraordinarily productive, and it has placed particular emphasis on avoiding environmental problems. Cleaning up a fuel before combustion—and I give a brief example in exhibit V—is a much neater way of minimizing pollution than trying to clean up products from that combustion.

I have to emphasize the importance of this kind of research. It is not normally considered to be environmental research, but I can assure you that it may well turn out to be the most important kind that we can perform.

More recent environmental research by the company has focused on three basic areas: Removal of trace quantities of pollutants from certain process steps, removal of arsenic from shale products, and revegetation of disturbed areas and spent shale piles.

In summary, that work is described in much more detail in exhibit VI.

I must point out that some of that work goes back quite a number of years—the revegetation work, specifically, goes back some 15 years.

It is our belief that the environmental research which has been done to date is fully adequate to begin commercial operations.

We know from long experience that research will continue on better ways to produce cleaner fuels, better ways to remove and handle trace impurities, and better ways to reclaim land.

The more we learn about any commercial operation, the more opportunities we find for research to improve those operations.

The next question we identified was: Are there problems that need more research right now?

We see two problems that could benefit from more research in the near-term future. Those two problems are visibility and the PSD increments.

The Clean Air Act, as you know, calls for prevention of any future impairment of visibility and the remedying of any existing impairment of visibility in mandatory class I areas established under the act.

Although this certainly is a laudable objective, the simple fact is that there is no reliable way to measure visibility impairment, much less any way to measure the effectiveness of additional control measures.

We think there is an immediate need for visibility research. Failure to have quantifiable means of measuring visibility impairment can only lead to project delays, possibly project denials, and certainly continued reliance upon foreign sources of energy to make up for shortfalls in domestic production.

The second research area is related to the prevention of significant deterioration, or PSD increments, that are imposed by the Clean Air Act to control any deterioration of air quality in clean air areas. Use of these increments, as you may well know, is dependent upon computer modeling of the path followed by any pollutants emitted from an industrial source.

The existing computer models are of questionable validity in flat terrain, and they are essentially worthless in the rugged terrain of shale country.

Again, we think there is an immediate and pressing need to either develop models that work in the rugged terrain or to modify the PSD provisions of the act.

Recent studies by the American Petroleum Institute, which already have been presented to the Senate Committee on Environment and Public Works, show that failure to resolve the PSD problems could result in only some 400,000 barrels per day of shale oil being produced by 1990, instead of the potential production level of some 800,000 barrels per day.

At today's crude oil prices, that 400,000-barrel-per-day shortfall represents some $5 billion per year that will, of necessity, flow out of the country for the importation of foreign crude oil.

Again, we think there is clear incentive for visibility and PSD modeling research, or for changes to the act to avoid these problems.

With regard to other types of research, we believe that research will be conducted by companies in the shale business and by developers of pollution control technology and devices. We see little need for any extensive Federal research beyond visibility and modeling at this time.

I sincerely hope we have addressed the items of interest to your respective subcommittees. I will be very pleased to try to respond to any questions which you may have.

[The prepared statement of Dr. Scott follows:]

STATEMENT OF

DR. CARLETON B. SCOTT

UNION OIL COMPANY OF CALIFORNIA

BEFORE THE

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

AND THE

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RESEARCH AND ENVIRONMENT,

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HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

OCTOBER 1, 1981

WASHINGTON, D.C.

89-263 O—82——2

Chairman Fuqua, Chairman Scheuer, members of the Subcommittees, my name is Carleton Scott and I am Director of the corporate Environmental Sciences Department of Union Oil Company of California. I am pleased to be here this afternoon to briefly describe Union's shale project and to respond to the environmental issues raised in your letter of invitation.

UNION'S SHALE OIL PROJECT

Construction currently is underway on a 12,500-ton per day room and pillar mine, an above-ground shale retort and a shale oil upgrading facility that will produce 10,000 barrels per day of low-sulfur, low-nitrogen synthetic crude oil. Start-up is scheduled for mid-1983. Current plans are to operate this Phase I facility for several months, and then to begin Phase II development to produce an additional 40,000 to 90,000 barrels of syncrude per day.

Union's shale resources are calculated to be some 1.6 billion barrels of recoverable oil, which would support a 100,000-barrel per day level of operation for nearly 45 years.

Additional details of the project are described in EXHIBIT I.

ENVIRONMENTAL ISSUES

The Subcommittees' letter of invitation raises a number of questions about the nature and adequacy of environmental research and development, environmental problems that may be encountered in the future, and the need for additional environmental R&D.

I will try to answer each of these questions from the perspective of a company that has been doing shale R&D for some forty years.

o Are Current Environmental Controls Adequate?

Concerns have been expressed over the possibility of new environmental or health risks resulting from production and use of shale oil.

Those of us working on a day-to-day basis with the legislative and regulatory controls covering shale believe these concerns have little basis in fact. The 21 major federal laws covering shale are listed in EXHIBIT II. When one combines these federal laws with the related state laws and the

associated regulations - generally ranging from a few score pages to several hundred pages each, it is difficult to find any credible area where an environmental or health loophole may exist.

Shale projects and products are exceptionally well covered by existing environmental and health laws and regulations. We see no justifiable opportunities for additional regulation.

o What Are The Current Environmental and Health Protection Steps?

Concerns similarly have been expressed that environmental risks may be greater with shale because the industry is so new that all possible regulations have not been put in place.

Essentially all of the environmental laws listed in EXHIBIT II are implemented through some sort of permit system. The 43 environmental permits applicable to Union's Phase I (10,000-barrel/day) project are listed in EXHIBIT III. It is important to note that most of these permits have specific environmental controls, standards and conditions that must be met, and that additional permits will be required for any modifications or expansions to the initial project.

In addition to the controls, standards and conditions that must be met through the permitting procedures, provisions of the Toxic Substances Control Act (TSCA) require consideration of the toxicities of shale products, of the risks that may be encountered in producing, marketing and using those products, and of the best means of minimizing those risks. Such work currently is under way, both within the Company and within toxicological laboratories engaged by the Company.

Preliminary contact has been made with EPA on this program, and we expect to maintain a close working relationship with EPA as the toxicological work moves forward. Our primary objectives in this work are to be sure that we meet both the letter and spirit of the law, that we fully understand any unusual risks that may exist, and that we fully protect our employees, our neighbors and the general public from any such unusual risks.

It is clear that an extraordinary network of regulations covers the shale industry, and that concerns over inadequate coverage are without any basis in fact.

o How Will Environmental and Health Protection Steps Be Monitored?

Questions have been raised about the effectiveness of environmental and health protection steps, and particularly if these steps will be rigidly implemented.

We see implementation being achieved through three basic mechanisms:

1. Enforcement By Agencies

The traditional and most obvious enforcement is by the federal, state and local agencies themselves. Both monetary and personal penalties are severe, and I believe it is safe to say that most enforcees take agency enforcement very seriously indeed.

2. Enforcement By The Company

Internal company compliance reviews or audits are becoming more elaborate and formalized, and I am pleased to say that Union has recently brought onstream an internal environmental and health

compliance review program that will continuously monitor the compliance status of the entire corporation.

The primary objective of this program is to assist facility managers in knowing about, and complying with, the multitude of regulatory requirements, and in locating and correcting any soft spots in compliance at the earliest possible stage. We believe this program will develop into a powerful tool for assuring continuous implementation of regulatory requirements.

3. Monitoring Required Under The Energy Security Act

An extensive monitoring program will be implemented by Union under conditions of the contract between Union and the United States that has been executed under the Energy Security Act (P.L. 96-294).

Details of this program, which are defined in EXHIBIT IV, cover the mine and retort, the shale oil upgrading facility, the waste rock and spent shale reclamation procedures, the socioeconomic commitments and obligations, the occupational exposure conditions of workers, the implementation of safety procedures and the monitoring of worker health.

The combination of these three mechanisms for assuring implementation of regulatory requirements is elaborate and unique. There can be little doubt about the effectiveness of the environmental and health protection steps.

o How Much Environmental R&D Has Been Done?

Questions have been raised about the extent and adequacy of environmental research and development for shale.

The scientific literature covering such research is substantial, and I will not make any effort to summarize that work in this statement. Perhaps the most productive way to address this issue is just to focus on the kinds of environmental research that Union has conducted since beginning shale work in the 1940's.

The initial environmental research was aimed at catalytic processes for removing potential pollutants - particularly sulfur, nitrogen and smoke-forming molecules - from the shale oil products. This work has continued over the years, it has been extraordinarily productive, and it is of particular importance in avoiding environmental problems. Cleaning up a

fuel before combustion, as shown in EXHIBIT V, is a much neater way of minimizing pollution than trying to clean up products from that combustion.

More recent environmental research has focused on removal of trace quantities of pollutants from certain process steps, removal of arsenic from the shale products, and revegetation of disturbed areas and spent shale piles. A summary of that work is described in EXHIBIT VI.

Environmental research done to date is fully adequate to begin commercial operations. We know, however, that research will continue on better ways to produce cleaner fuels, better ways to remove and handle trace impurities and better ways to reclaim land. The more we learn about any commercial operation, the more opportunities we find for research to improve those operations.

o Are There Problems That Need More Research Right Now?

We see two upcoming problems that could benefit from more research in the near-term future.

1. Visibility

The Clean Air Act calls for the prevention of any future impairment of visibility, and the remedying of any existing impairment of visibility, in mandatory Class I areas established under the Act. Although this is a laudable objective, the simple fact is that there is no reliable way to measure visibility impairment, much less any way to measure the effectiveness of additional control measures.

There is an immediate need for visibility research. Failure to have quantifiable means of measuring visibility impairment can only lead to project delays, possibly project denials, and certainly continued reliance upon foreign sources of energy to make up for shortfalls in domestic production.

2. PSD Increments

The Clean Air Act similarly calls for the use of air quality increments (Prevention of Significant Deterioration - PSD increments) to control any deterioration of air quality in clean-air areas. Use

of these increments is dependent upon computer modelling of the path followed by any pollutants emitted from an industrial source.

Existing models are of questionable validity in flat terrain, and are essentially worthless in the rugged terrain of shale country.

There is an immediate and pressing need to either develop models that work in rugged terrain, or to modify the PSD provisions of the Act. Recent studies by the American Petroleum Institute - which have been presented to the Senate Committee on Environment and Public Works - show that failure to resolve the PSD problems could result in only some 400,000 barrels per day of shale oil being produced by 1990, instead of the potential production level of some 800,000 barrels per day. At today's crude oil prices, that 400,000-barrel per day shortfall represent some $5 billion per year that will - of necessity - flow out of the country for the importation of foreign crude oil.

There is clear incentive for visibility and PSD modelling research, or for changes to the Act to avoid these problems.

Other research will be conducted by companies in the shale business, and by developers of pollution control technology and devices. We see little need for any extensive federal research beyond visibility and modelling at this time.

I hope this statement has addressed the items of interest to your respective Subcommittees.

I will be pleased to respond to any questions.

EXHIBIT I

UNION OIL COMPANY'S PARACHUTE CREEK SHALE OIL PROJECT

POSITION PAPER

BACKGROUND DATA

In 1920, more than 60 years ago, Union began acquiring oil shale properties in the Parachute Creek area of Garfield County, Colorado. The oil shale lands Union owns contain some 1.6 billion barrels of recoverable oil in the high yield Mahogany zone alone. These reserves are large enough to produce some 100,000 barrels of shale oil per day for nearly 50 years.

In the early 1940s Union began to try to develop this resource, operating a small, 50-ton-per-day pilot retort at its Los Angeles Refinery. From 1955 - 1958, Union built and operated a retort in Parachute Creek, processing up to 1,200 tons of ore per day and producing up to 800 barrels of shale oil per day. The low price of crude oil forced Union to suspend actual development at that time but research efforts to further improve Union's unique upflow retort process continued.

Following the oil shortages caused by the Arab oil embargo in 1973 and the rapid rise in world oil prices, Union accelerated its efforts to achieve commercial production of this vast resource.

CURRENT STATUS

In February 1978, Mr. John Hopkins appeared before the Garfield County Commissioners and announced plans for the

first phase of a project to develop the first commercial shale oil project in Colorado and the nation. This first phase will include a mine, retort and upgrading facility that will process 12,500 tons per day of oil shale and produce 10,000 barrels per day of high quality syncrude that would be a preferred petroleum feedstock in any of the nation's modern refineries.

Union began the permitting process in March 1978 and now has all federal, state and local permits for the shale oil and upgrading plants (Phase I).

Necessary road work began in the fall of 1980 and predevelopment mining operations began in January 1981. Over 500,000 tons of material have been mined to date, opening up the various mine shafts preparatory to production mining.

Underground mine development is proceeding, the bench site for the retort is complete and preparations for the upgrading facility in the valley are underway. Engineering on the retort and upgrading plant are in progress and all major equipment orders have been placed.

Union plans to begin on site construction of the retort and upgrading facility early in 1982 and complete the project by mid-1983.

GOVERNMENT CONTRACT

Because of the nation's urgent need for domestically produced energy and in the belief that adequate financial assistance could be negotiated with the federal government, Union began work on the project in January 1981, after being notified that it had been selected to negotiate a contract with the

U.S. Department of Energy. This mining, retorting and upgrading complex will cost an estimated $500 million.

On July 29, 1981, after months of negotiations with two administrations, Union Oil Company entered into an agreement for a Department of Energy award for the first commercial production of oil from shale in the United States. As part of the agreement, and beginning with actual shale oil production, Union will deliver 3,000 barrels per day of military aircraft turbine fuel and 7,000 barrels per day of diesel fuel to the Department of Defense.

The price at time of delivery will be the market price. If this price is below the DOE contract floor price of $42.50 per barrel (indexed for inflation), Union will receive a payment from the government equal to the difference. The price support will apply for a period commencing on July 1, 1983, but only if production has started by that date and ending on the earlier of June 30, 1990, or the date by which the synthetic fuel facility has produced 20 million barrels of syncrude. In any event the total price support cannot exceed $400 million.

The market price will be the sum of 30 percent of the price DOE is paying for JP-4 and 70 percent of the price of #2 and marine diesel fuel. This comes to $42.50 per barrel as a July 1, 1981 bench mark figure.

The price differential or price support (above market price) will be based on the sum of 75 percent of the change in the Implicit Price Deflator for the GNP and 25 percent of any change in the average price paid by domestic electrical utility

generating plants for natural gas for the quarter over the base period.

If the price of oil escalates faster than inflation, the government will pay only the market price and there will be no subsidy of any kind. Also, all technological risks are Union's. Unless and until Union produces oil and shale, the government has no responsibility or liability.

SOCIAL IMPACTS

Union recognizes the substantial impacts on housing and public services that the rapid influx of employees and their families is having on the town of Parachute and neighboring communities. Besides housing, these include water and sewer systems, public safety, schools, recreational facilities, highways and public administration.

As stated when we first announced plans for the project in 1978, Union is prepared to work closely with local officials to help solve problems -- hopefully before they arise. Every effort has been and will be made to assist in handling population growth in an effort to preserve the life style enjoyed in western Colorado.

Workers now employed on the project, as reported to the county quarterly, total about 1,200. This figure will rise to 1,600 in the second quarter of 1982 and average about 1,500 for much of next year. As the project nears completion in 1983, this figure will decline and should stabilize at about 400 (including those headquartered in Grand Junction) during the operating phase of operation.

Union has already expended or committed $60 million through 1983 to help alleviate the socioeconomic impacts of the project in the town of Parachute and throughout Garfield County. (See table on following page.) This $60 million being spent initially for impact assistance is 12 percent of the $500 million projected as the cost of the project, well above the 10 percent of our project cost once suggested by Governor Lamm.

As part of this program of impact assistance Union has built, or has under construction 192 apartment units, 129 condominiums and townhouses and 40 mobile home units. Union owns property in Parachute and Rifle that can accommodate up to 1,400 dwelling units as the need arises.

UNION OIL COMPANY OF CALIFORNIA
LONG RIDGE OIL SHALE PROJECT
COMMUNITY IMPACT MITIGATION

Single Status Housing (to minimize number of employees living in community)		$25,200,000
Investment	$22,300,000	
Subsidy	2,900,000	
Housing for Construction and Permanent Employees		$22,116,500
Apartments and mobile homes in Parachute	$11,000,000	
Condominium units in Rifle	8,500,000	
Land in Rifle for future housing	2,616,500	
Direct Assistance to Community		$12,569,800
Parachute bypass	500,000	
Upgrade County Road 215	6,000,000	
Rifle bypass	93,000	
Garfield County sheriff's department	210,000	
Garfield County solid waste study	25,000	
Parachute law enforcement	93,000	
Parachute administration	19,000	
Parachute emergency medical services	4,800	
Parachute water and sewer tap fees	600,000	
Parachute annexation fees	250,000	
Parachute middle school	4,200,000	
Grand Valley fire district	75,000	
Parachute park land	150,000	
Air Methods Inc. - emergency helicopter services	-	
Total Impact Mitigation		$59,586,300

STATUS OF HOUSING

PARACHUTE			
Apartments (192)			
In process of being occupied		72	
Under construction and to be occupied:			
	August 1981	24	
	November	24	
	December	48	
	January 1982	24	
			192
Mobile homes (40) (70 foot long, 3 bedrooms)			
Complete (Now housing 120 singles; when construction camp complete these will house 40 familes)		40	40
RIFLE			
Condominiums or townhouses (129)			
Complete		29	
Under construction & to be completed in:			
	August	20	
	September-November	80	
			129
			361
SINGLE STATUS HOUSING (750)			
Under construction for occupancy in mid-September		750	

Some five miles north of the town of Parachute, Union also has under construction single workers housing to accommodate 750 workers during the construction phase of the project. This project includes a cafeteria and a large recreation center to help relieve the burden on the town of Parachute that could result from the influx of workers brought in by the shale oil project. This will be enlarged to accommodate up to 1,400 workers if the need arises.

Also included is approximately $4.2 million of financial assistance for a new middle school to serve Parachute and adjoining areas of Garfield County.

Union has built a highway bypass around the town of Parachute and is spending $6 million to improve County Road 215 leading to the project site.

Union has given the town of Parachute $600,000 as advance payment for 200 sewer and water taps. In addition, $250,000 has been paid to the town for purchase of additional water rights and to improve recreational facilities.

During the construction phase, Union is providing Parachute and Garfield County with funds to hire and outfit seven police and sheriff's officers. Union also is providing Parachute with financial assistance for emergency medical services and administrative requirements.

Problems now unforeseen undoubtedly will arise. Union will work closely with local and county officials to attempt to mitigate these problems as expeditiously as possible.

ECONOMIC BENEFITS

Union's studies, and those of outside consultants, indicate that once the 10,000 barrel per day Phase I project is on stream, the taxes and other revenues received by the state, county and local communities will more than offset the cost of additional services and facilities required.

The assessed value of the project will be about $120 million. Tax rates for various affected assessment districts vary, but now range up to about a 100 mil rate. When Union's Phase I project is completed and on the tax rolls, it should result in an actual reduction in the property tax rate. In addition, new housing in Parachute, Rifle and other communities will generate new property tax revenues. Combined, these increased property tax remittances will more than pay for the additional services and facilities that the increased population will require.

In addition the sales tax generated (3¢ state, 2¢ for Rifle and Parachute) will provide substantial funds for local services.

We estimate that during the construction phase of the project the payroll will average some $25 million. After state and federal taxes the workers should have some $15 million of disposable income. During the operating phase beginning in mid-1983 these figures would be about $12 million and $8.5 million respectively.

Because of the minimal level of retail and service facilities now existing in Parachute, it is difficult to project the portion of wages that will be spent locally.

Unless there are some barriers to development that we are not aware of, however, we would expect that the free enterprise system will encourage a wide variety of commercial establishments to be built that will result in most of this disposable income being spent in Parachute and throughout Garfield County.

In addition, Union is, and will continue to purchase project supplies, equipment and services in Garfield County whenever possible. This is beneficial to us and the employment and sales revenues and taxes benefit the county and local communities.

ENVIRONMENTAL PROTECTION

Changes in the land surface resulting from construction of the mine and processing facilities will not be visible outside the upper Parachute Creek Valley. Because of the isolated location of the private property where operations are planned, alterations in the topography will be apparent only to visitors coming to the site on business.

Steps will be taken to preserve and restore vegetation and to protect the area's wildlife and wildlife habitat. Revegetation of retorted shale has been successfully demonstrated and will be carried out on the retorted shale disposal areas. Union has worked with Colorado State University on the development of optimum vegetation methods.

A primary goal will be to safeguard existing ground and surface waters. The bottom ten-foot layer of retorted shale will be compacted to reduce permeability, precluding water movement upward or downward.

Monitoring of retorted shale is planned, and erosion testing is an on-going activity.

During construction and operation of the shale oil project, air quality in the immediate operating area will be protected. Special controls will be installed as part of plant construction. Exhaustive studies indicate that the low emission levels will meet all federal and state air quality standards and will not be harmful to residents of the area, to vegetation or to wildlife.

As operations begin, Union continuously will monitor environmental factors to ensure that standards are being met.

Water required in the first 10,000 barrel per day phase of the project's operations will be taken from wells on Union's property and will be recycled to minimize water requirements. Union's water rights were secured many years ago as a part of the company's long-term plan for shale development. Project design also includes detailed plans to prevent contamination of local streams and underground basins. As future retorts and process facilities are added, water also will be drawn from the Colorado River, where Union has long-established water rights.

All of these activities are designed to ensure an environmentally acceptable operation.

FUTURE DEVELOPMENTS

As Union has stated from the onset of the project, the development of our oil shale resource is being done in phases. After completion of the 10,000 barrel a day Phase I mine, retort and upgrading facility,it will be operated for several

months. During this preliminary operating phase we expect to develop process improvements, improve our environmental controls and develop further economic data on all aspects of the project.

We will then begin Phase II development which will add 40,000 barrels a day of capacity, bringing production to 50,000 barrels a day by 1988.

Recent detailed engineering and economic studies indicate that the optimum size of our project would result in production of 100,000 barrels a day of shale oil and syncrude. To minimize the delay in beginning construction until all necessary permits are secured we plan to begin the permitting process on county, state and federal levels for a full 100,000 barrel a day project in the near future.

Our first mine, for Phase I, is located some 1,000 feet above the valley floor on the north wall of the east fork of Parachute Creek. As we proceed with further development we also plan to construct mines and retorts on the south wall where we also own, in fee, additional property containing rich oil shale deposits.

While syncrude from the Phase I project will be transported out of Parachute by truck or rail, the expanded facility will justify construction of a pipeline to move the syncrude to a refinery or to an existing crude oil pipeline.

The main impact of the project is being experienced during the current, Phase I portion of the development. For Phase II, the single status housing will be in place; employment

levels will not be materially different than during Phase I; and major tax revenues will be flowing to state, county and local levels of government to provide expanded services that may be required.

Permanent employees, for at least the 45 to 50 year projected life of the project, will total about 1,000 for a 50,000 barrel a day project and 1,500 for the 100,000 barrel projected ultimate production level.

August 11, 1981
Revised September 24, 1981

EXHIBIT II

MAJOR FEDERAL ENVIRONMENTAL AND HEALTH LAWS

APPLICABLE TO SYNTHETIC FUELS PROJECTS

- Clean Air Act
- Clean Water Act
- Resource Conservation and Recovery Act
- Safe Drinking Water Act
- Federal Land Policy and Management Act
- Antiquities Act
- Wilderness Act
- Toxic Substances Control Act
- Surface Mining Control and Reclamation Act
- Endangered Species Act
- Energy Supply and Environmental Coordination Act
- National Environmental Policy Act
- Coastal Zone Management Act
- Water Resources Planning Act
- Nonnuclear Energy Research and Development Act
- Noise Control Act
- Archaeological Resource Protection Act
- National Historic Preservation Act
- Occupational Safety and Health Act
- Rivers and Harbors Act
- Fish and Wildlife Coordination Act

EXHIBIT III

PERMITS FOR 10,000 BPD MINE, RETORT, and UPGRADING FACILITIES ISSUED TO UNION

(as of October 1981)

FEDERAL

Agency	Permit	Facility	Date
EPA	PSD	Mine and Retort	07/31/79
EPA	PSD	Upgrade	05/27/81

STATE OF COLORADO

Agency	Permit	Facility	Date
MLRB	Development and Extraction Mining (78-263)	Mine and Retort	08/02/79
Colorado Dept. of Health	Storage Tank Syn-Crude (C-11,904-11)	Upgrade	04/30/81
Colorado Dept. of Health	Storage Tank Syn-Crude (C-11,904-12)	Upgrade	04/30/81
Colorado Dept. of Health	Storage Tank Fuel Oil 1 (C-11,904-13)	Upgrade	04/30/81
Colorado Dept. of Health	Storage Tank Fuel Oil 2 (C-11,904-14)	Upgrade	04/30/81
Colorado Dept. of Health	Storage Tank Jet Fuel 1 (C-11,904-15)	Upgrade	04/30/81
Colorado Dept of Health	Storage Tank Jet Fuel 2 (C-11,904-16)	Upgrade	04/30/81
Colorado Dept. of Health	Storage Tank Diesel 1 (C-11,904-17)	Upgrade	04/30/81
Colorado Dept. of Health	Storage Tank Diesel 2 (C-11,904-18)	Upgrade	04/30/81

Agency	Permit	Facility	Date
Colorado Dept. of Health	Practionator Reboiler H3401 (C-11,904-5)	Mine and Retort	08/13/79
Colorado Dept. of Health	Vapor Disposal Unit V7001 (C-11,904-6)	Mine and Retort	08/13/79
Colorado Dept. of Health	Pilot Retort Vent Stack (C-11,904-7)	Mine and Retort	08/13/79
Colorado Dept. of Health	Product Storage Tank (Fuel Air) T7001 (C-11,904-8)	Mine and Retort	08/13/79
Colorado Dept. of Health	Bag Filter Control (1 & 2) (C-11,904-9)	Mine and Retort	08/13/79
Colorado Dept. of Health	Bag Filter Control for Retort Feed Conveyor (C-11,904-10)	Mine and Retort	08/13/79
Colorado Dept. of Health	Earthmoving e Activities (C-11,904-FD-0-1)	Mine and Retort	08/13/79
Colorado Dept. of Health	Underground Excavation, Crushing Stockpiling s, (C-11,904-FD-0-2)	Mine and Retort	08/13/79
Colorado Dept. of Health	Mine Vent (C-11,904-FD-0-3)	Mine and Retort	08/13/79
Colorado Dept. of Health	Administration Area Construction (C-11,904-FD-C-1)	Mine and Retort	08/13/79
Colorado Dept. of Health	Preproduction Mine Development (C-11,904-FD-C-2)	Mine and Retort	08/13/79
Colorado Dept. of Health	Bench Site Construction (C-11,904-FD-C-3)	Mine and Retort	08/13/79

Agency	Permit	Facility	Date
Colorado Dept. of Health	Steam Boiler (C-11,904-19)	Upgrade	04/30/81
Colorado Dept. of Health	Dearseniter Charge Heater (C-11,904-20)	Upgrade	04/30/81
Colorado Dept. of Health	Fractionator Reboiler Heater (C-11,904-21)	Upgrade	04/30/81
Colorado Dept. of Health	Hydrogen Charge Heater (C-11,904-22)	Upgrade	04/30/81
Colorado Dept. of Health	Reformer Furnace (C-11,904-23)	Upgrade	04/30/81
Colorado Dept. of Health	Dearseniter Purge Heater (C-11,904-24)	Upgrade	04/30/81
Colorado Dept. of Health	Emergency Flare (C-11,904-26)	Upgrade	04/30/81
Colorado Dept. of Health	Misc. Hydrogen Sources from Seals, Valves, Flanges (C-11,904-27)	Upgrade	04/30/81
Colorado Dept. of Health	Construction Related Activity (C-11,904-28)	Upgrade	04/30/81
Colorado Dept. of Health	Recycle Gas Heater (C-11,904-1)	Mine and Retort	08/13/79
Colorado Dept. of Health	Steam Boiler B3701A (C-11,904-2)	Mine and Retort	08/13/79
Colorado Dept. of Health	Steam Boiler B3701B (C-11,904-3)	Mine and Retort	08/13/79
Colorado Dept. of Health	Pilot Flare Stack (C-11,904-4)	Mine and Retort	08/13/79

Agency	Permit	Facility	Date
Colorado Dept. of Health	Mine Road Construction (C-11,904-FD-C-4)	Mine and Retort	08/13/79
Colorado Dept. of Health	Spent Shale Disposal Road (C-11,904-FD-C-5)	Mine and Retort	08/13/79
Colorado Dept. of Health	Drainage Pond Construction (C-11,904-FD-C-6)	Mine and Retort	08/13/79
Garfield County	Special Use Permits	Construction Camp	
Garfield County	Special Use Permits	Upgrade Facility	
Garfield County	Special Use Permits	Rail Spur	
Garfield County	Special Use Permits	Pipeline - not issued	

EXHIBIT IV

ENVIRONMENTAL MONITORING REQUIREMENTS

UNION OIL COMPANY OF CALIFORNIA

(10,000 BPD FACILITY)

A. Requirements under PSD pursuant to the Clean Air Act

1. Mine and Retort

(a) All major SO_2 point sources will be continuously monitored and quarterly grade samples will be analyzed for other sulfur compounds. Continuous monitoring need not be performed on all stacks of like units.

The Stretford unit inlet and the exit gas stream, i.e., the fuel gas will be continuously monitored for H_2S.

One of the steam boilers will be continuously monitored for SO_2 in order to provide continuous information on the amount of non-H_2S sulfur compounds going through the Stretford unit.

(b) Mine vent particulates will be measured monthly for TSP and trace elements.

(c) Monthly grab samples from major point sources will be analyzed for NOx and NMHC.

(d) Ambient monitoring will be in the form of:

(1) Continuous SO_2 at two locations--one on site and the other in Parachute.

(2) TSP samples on a once every seventh day frequency at these same two sites.

(3) WS/WD at these two locations.

(4) Three to five grab samples for SO_2 at the east end of the East Fork of Parachute Creek.

(e) In general, performance tests will be required on all 25 ton per year (controlled) pollutant sources and continuous monitoring required on 100 ton per year (controlled sources).

The Stretford inlet and exit gas streams will be performance tested for sulfur compounds including H_2S, SO_2, RSH, COS and CS_2, at least three times during the first three years of normal operations at maximum rated capacity. If variations are small and emissions conform

to PSD permit limits, performance testing may be discontinued after three tests. The continuous monitoring requirement will be reassessed as discussed below.

The recycle gas heater and one of the steam boilers will be performance tested for SO_2 and NOx at least three times during the first three years of operation as the maximum rated capacity. If emissions conform to PSD permit limits, no additional performance testing will be required.

Annual performance tests shall be conducted on one additional "like" stack for the first three years of continuous full scale operation. If the variations between the stacks and among the tests is less than 25 percent, further performance testing is not required and the continuous monitored stack may be considered to be representative of all "like" stacks. If variations are greater than 25 percent, more frequent performance tests, performance tests on additional stacks, continuous monitoring on additional stacks, or some combination of the above may be required by EPA. Research tests performed by EPA, DOE or others may be used in lieu of an annual performance test if the research test is performed under EPA approved methods.

(f) TSP emissions resulting from blasting operations will be assessed via an EPA method 5 performance test on the mine exhaust. TSP emissions resulting from the remaining underground activities will be measured at the mine adit. These tests will be conducted at least two times per year during the first three years of normal full scale mining operations. If emission rates conform to PSD permit limits, no further performance testing will be required.

TSP emissions resulting from "finish screening" will be performance tested at the baghouse outlet. Three performance tests will be conducted during the first three years of operation at maximum rated capacity. If emissions conform to permit limits, no further testing will be required.

(g) Random sampling for particulates in spring, summer and fall at the retort site and shale disposal area during construction.

(h) No later than one year prior to the commencement of retorting operations Union will submit an ambient air quality monitoring plan to EPA and the Colorado Air Pollution Control Division for their review and approval.

2. Upgrade Facility

(a) Random sampling for particulates in spring, summer and fall at the construction site during construction.

(b) Emissions from the sulfur recovery plant will be limited to 0.030 percent by volume of reduced sulfur compounds and 0.0010 percent by volume of hydrogen sulfide calculated as sulfur dioxide at zero percent oxygen on a dry basis.

(c) H_2S concentrations in fuel gases will not exceed 0.10 grains/scf.

(d) A continuous SO_2 monitor system will be operated on the exit gas stream of the sulfur recovery unit incinerator.

(e) A continuous H_2S monitor system will be operated on fuel gases to be burned.

(f) Performance tests will be conducted on all major sources.

(g) No later than one year prior to commencement of upgrade operations, Union will submit an ambient air quality monitoring plan to EPA and the Colorado Air Pollution Control Division for their review and approval.

B. Requirements under MLR Permit Pursuant to Mined Land Reclamation Act

1. Union will salvage and properly stockpile all available topsoil prior to disturbance of any area associated with the construction of the retorted shale pile, access/haul roads and all other surface facilities.

2. Prior to seeding, topsoil will be spread on the retorted shale pile to a depth that is determined by the MLRB staff to be consistent with the topsoil survey and the resultant topsoil balance calculations. Topsoil will be respread on all other surface disturbances during the reclamation phase in a similar fashion after final abandonment and prior to reseeding.

3. Due to the experimental nature of the operation, the construction of the waste dumps will be conducted in two phases. Phase I will consist of the placement and concurrent reclamation of the western pile. Phase II will consist of the placement and concurrent reclamation of the eastern pile.

4. Union will review the data obtained from Dr. Berg's south facing test plots after the first and second growing season.

5. After the experimental retort is functioning, Union will sample the material coming from the retort to determine if the chemical and physical properties of this material differ significantly from the retorted shale used in Dr. Berg's south facing test plots established in 1979.

6. Union will establish a series of experimental one-acre plots on the south facing slope of the disposal pile.

7. All diversion ditches will be removed during the reclamation phase of the operation.

8. Union will institute field research studies which address the expected water balance of the pile.

9. Union will perform field compactibility studies on the Process B retorted shale to determine if the impermeable zones are being constructed as planned.

10. Union will perform trace element studies on vegetation grown on Process B retorted shale to provide insight into potential plant and animal toxicity problems associated with Process B retorted shale.

11. Union will finalize the water supply plans prior to startup of retort operations.

12. Five years from date of permit issuance and every year thereafter, the MLRB will reevaluate the bond to determine its adequacy and require changes as needed.

13. Union will submit results of the above research and monitoring to MLRB staff for review and recommendation.

14. Groundwater samples will be collected weekly, monthly or quarterly depending on the parameter from five areas (10 wells) in East Fork of Parachute Creek. This area does include the retorted shale pile. These samples are to be analyzed for a full suite of parameters.

15. Surface water samples will be collected weekly, monthly or quarterly depending on the parameter from five locations on Parachute Creek including the East Fork where the retorted shale pile will be placed. These samples are to be analyzed for a full suite of parameters. Stream gauges are maintained on all branches of Parachute Creek to obtain stream flow data.

16. Runoff monitor samples will be collected from the retorted shale pile when it is placed. The actual plan has not yet been developed.

17. Union will monitor the rate of new soil development in the retorted shale pile vegetation root zone in a program to be developed by Union prior to any disposal of retorted shale and submitted to DOE. (This is required by this Agreement, not by the MLRB permit.)

C. Socioeconomic Commitments and Obligations of Union:

1. Union acknowledges the need to provide timely front-end financing for housing and municipal facilities and services in order to accommodate

the population growth associated with development of the synthetic fuels industry, and establishes the following procedures for actions to mitigate such impacts.

2. Union further acknowledges its responsibility to bear its appropriate share of such front-end financing and to work actively with state and local officials to mitigate the cumulative socioeconomic impacts of commercial energy development in western Colorado.

3. Union agrees to participate in the Cumulative Impacts Task Force, chaired by the Colorado Department of Natural Resources, or similar group agreed to by Union, the Governor of Colorado, and the Garfield County Commissioners, to determine an equitable formula for the level of financing to be provided by private industry to meet these needs for front-end financing. Any formula shall give credit to Union for its past and currently projected expenditures for public facilities and services and for housing in the impacted area, and may require additional expenditures by Union.

4. Union will participate in a socioeconomic impact monitoring program in cooperation with the Colorado Department of Local Affairs, Garfield County, and other local governments affected by the development and operation of the synthetic fuel production facility. Union shall monitor and report projections of the Union work force for the county of Garfield every three months (sooner if there is a ten percent variance from projections) including residence, type of housing, number of school children and other information required by the county. Copies of these reports shall be submitted by Union to DOE.

5. In addition to the foregoing Paragraphs 1-4, Union shall:

   (a) Guarantee financing for construction of the Parachute, Colorado, middle school.

   (b) Prepay 200 water and sewer fees to the town of Parachute, Colorado, to enable the town to expedite expansion of its sewer and water systems.

   (c) Monitor and report projections of Union's work force for the county of Garfield every 3 months (sooner if there is a 10 percent variance from projections) including residence, type of housing, number of school children and other information required by the county.

   (d) Insure that housing is available for 80 percent of Union's work force.

   (e) Pay for, or financially support entrepreneurs in constructing, a single construction camp (1,425 maximum capacity), 245 family status units in Parachute, Colorado, and 400 faimily status units in Rifle, Colorado.

(f) Cooperate with the school system to mitigate impacts caused by any increase in Union's employees.

(g) Provide transportation from the construction camp to the facility.

(h) Establish an emergency medical plan with the County Health Officer and Health Care Agencies.

(i) Provide Garfield County law enforcement with funds for five additional officers and equipment.

(j) Provide the town of Parachute with funds for a police car and two officers.

(k) Provide the town of Parachute with funds for additional costs of administration and emergency medical services.

(l) Provide funds to Grand Valley Fire District for a fire truck, ambulance, and a portion of the living quarters.

(m) Build a by-pass road (County Road 215) around the town of Parachute to preclude heavy traffic moving through the town and near the school. Pave balance of the road to Class B standards.

(n) Union will make certain surplus equipment available to the town of Parachute.

D. Occupational Exposure Conditions Monitoring

1. Health

(a) Preliminary workplace health surveys to include sampling and analysis, as appropriate, of waste and process streams with which employees are likely to have contact for toxic substances, including those which are carcinogenic or teratogenic, as well as physical agents.

(b) Detailed monitoring surveys and analysis of those potential health hazards indicated by preliminary surveys.

(c) Each area of the workplace shall be examined by an industrial hygenist, during and after construction, to identify potential health hazards. Union shall apply feasible engineering controls where necessary to reduce or eliminate potential health hazards, as defined by the hygenist or as evident from sampling and analysis. Where engineering controls are not feasible, workers will be protected by personal, protective equipment.

2. Safety

The safety of employees will be addressed by education and training, the development and implementation of safe operating procedures, machinery and equipment guarding, requirements for use of personal, protective equipment and auditing by different levels of management to assure ongoing accident prevention efforts.

E. Worker Health

As set forth in Article 20.4, physical examinations initially will be given annually, with the frequency subject to change depending upon results of these examinations as well as results of upcoming toxicological work on shale products. Examinations will be conducted by Union physicians.

F. An analysis of the results of the above monitoring activities shall be performed as set forth in Article 21.2.

EXHIBIT V

SIGNIFICANT PROPERTIES OF RAW AND UPGRADED SHALE OILS

COMPARED WITH THOSE OF HIGH GRADE PETROLEUM CRUDE

	RAW SHALE OIL UNTREATED	UPGRADED SHALE OIL "SYNCRUDE"	TYPICAL DATA FOR HIGH GRADE PETROLEUM CRUDE
Gravity, ^{o} API	22	37	35
Sulfur, wt %	0.9	0.002	1.7
Nitrogen, wt %	1.8	0.025	0.08
Total Aromatics, vol %	19	16	30

EXHIBIT VI

RECENT OIL SHALE DEVELOPMENT PROGRAM AT

UNION SCIENCE & TECHNOLOGY CENTER

I. AIR POLLUTION CONTROL

A. Retort Makegas H_2S Removal

1. Stretford Process Evaluation

a. 1976 Test Work

Purpose: evaluate H_2S removal efficiency, chemical losses and sulfur quality.

b. 1980 Test Work

Purpose: evaluate chemical losses.

2. Unisulf Process Evaluation

a. 1979-1980 Test Work

Purpose: evaluate H_2S removal efficiency, chemical losses, sulfur quality and effect of gas contaminants on process operability.

B. Retort Makegas COS Removal

1. Dry Phase COS Conversion

a. 1978 Test Work

Purpose: evaluate operating conditions and COS conversion efficiency to H_2S using hydrotreating catalysts.

2. Liquid Phase OCS Conversion

a. 1980-1981 Test Work

Purpose: evaluate COS conversion efficiency to H_2S, chemical byproduct buildup and operating conditions using an aqueous phase hydrolysis solution.

C. Retort Makegas NH_3 Removal

1. Ammonia Absorption From Makegas

a. 1980-1981 Test Work

Purpose: determine operating parameters for absorption of NH_3 from retort makegas using an aqueous solution.

II. HAZARDOUS SOLIDS CONTROL PROGRAM

A. Arsenic Removal From Shale Oil

1. 1973-1976 Process Development Program

Purpose: develop solid phase absorbants for removal of arsenic from shale oil.

2. 1976-1980 Demonstration Program

Purpose: demonstrate arsenic removal in large scale pilot plants.

III. VEGETATION PROGRAM FOR RETORTED & DECARBONIZED SHALE

Parachute Creek, Colorado

1966 - Started vegetation work on Retort A ash disposal site, continues as natural study with no further irrigation or fertilization of the alfalfa and other plants.

1974 - Started decarbonized shale revegetation studies with Agronomy Dept. of Colorado State University. Installed eight valley plots and six plateau plots.

1975 - Installed fourteen new valley plots for retorted shale studies by CSU personnel.

- All valley plots instrumented with salinity sensors neutrons probe access tubes for moisture profile determinations and thermocouples on the west-facing Retort B plots for temperature measurements.

- Mulching, leaching, fertilization and seeding of the valley and plateau plots performed during 1974 and 1975.

- Erosion control studies performed by U.C. Davis utilized various mulching applications. Erosion control studies started on valley 2:1 slopes in 1975 and continue to date.

1979 - Constructed 14 new 1.7:1 south-facing retort B plots with CSU personnel below the old demonstration plant site. These new plots were leached, mulched, fertilized and planted by CSU personnel in 1979.

- All studies on the valley, plateau and new 1.7:1 plots continue with yearly reports issued by CSU personnel.

Brea Research Center Studies

1973 - Greenhouse and lysimeter studies began to assist Retort A disposal pile tests and to develop methods for vegetating decarbonized shale.

1975 - Constructed large 16' x 52' concrete lysimeter to study compaction, permeability, leaching, mulching, fertilization and vegetation of retorted shale.

- Filled with 148 tons (dry weight) of quenched retorted shale from Unit 60 pilot plant in 8" layers and compacted to average dry density of 87 lbs/cu ft.

- Contains a 4:1 south-facing slope (16' x 24'), a flat center surface (16' x '6.5'x6' deep) and a north-facing 1.7"1 slope (9.8' x 16').

- Now planted with Colorado native species that are periodically fertilized, irrigated and evaluated.

1976 - Constructed three concrete, west-facing, 4:1 slope lysimeters for decarbonized shale studies. South and center plots were filled with decarbonized shale produced from 34 gpt raw shale and the north plot was filled with retorted shale made from 34 gpt shale.

1977/79 - Native Colorado species were seeded on lower halve of the three plots and three barley crops were grown on the upper halves after leaching, mulching, and fertilizing treatments.

1979/79 - South plot was emptied of decarbonized shale and filled with 41 gpt retorted shale.

- All three plots now contain native Colorado species that are periodically irrigated, fertilized and evaluated for growth performance.

Long Ridge Experimental Shale Oil Project

union 76

Union Oil Company
of California

Colorado's Oil Shale Reserves

Rocky Mountain oil shale is one of the major energy resource potentials in Colorado and the nation. Shale oil can replace fuel oil and conventional crude oil and is currently considered an important potential domestic energy reserve.

A government study estimates there are 1.8 trillion barrels of high grade shale oil locked in the Green River formation in western Colorado, Utah and Wyoming. If only 600 billion barrels, or one-third of this shale oil, is ultimately recovered this would still be 20 times the nation's presently proved crude oil reserves.

Production of this energy resource, however, awaits development of mining and processing methods which are still in the experimental stages. Therefore, vast oil shale deposits remain a potential rather than a real part of the nation's energy reserves.

Union Oil Company of California plans to help convert these vast potential resources into usable energy for Colorado and the nation. With the help of answers provided by the experimental plant Union proposes to build, the company should be able to establish a new source of energy to supplement shrinking domestic crude oil and natural gas reserves.

This brochure describes Union's plans for an experimental oil shale project and the steps to be taken to establish the commercial feasibility of shale oil production.

Union Oil Company's Long Ridge Experimental Shale Oil Project

Union Oil Company of California has reactivated plans to build and operate an experimental oil shale retorting project in the Parachute Creek area, north of Grand Valley, Colorado. The plant will define further the technical, environmental and economic feasibility of the process Union has developed to produce shale oil.

Union's decision to reactivate its oil shale project is based on the belief that it is now clearly in the national interest to press ahead with the necessary work to prove the technical aspects of a full-scale retorting module. We also must confirm the economic, environmental and political conditions necessary for private industry to develop our shale oil reserves.

Recognizing the gravity of the long-term energy situation, Union is starting immediately to secure the necessary local, state and federal permits and approvals. Construction of an experimental oil shale mine and retorting facility can then begin at the earliest possible date.

The experimental project will include a mine, a large shale retorting unit, truck loading facilities for shipment of the product, provisions for disposal of the retorted shale and necessary support facilities.

The project will be designed to process 10,000 tons of shale and produce about 9,000 barrels of shale oil daily. Processing will be in the upflow retort developed by Union's research staff. The product immediately will be suitable for use as fuel oil in electrical power generating plants.

This project is the next logical step in the development of Union's oil shale process and the company is confident that it will accomplish these objectives:

- Establish the operating limits of a full-size retorting module.
- Develop process improvements which can only be accomplished in a large experimental facility.
- Secure economic data needed for any future commercial development.

Union's
Oil Shale
Holdings
DENVER
COLORADO
GRAND
JUNCTION
PUEBLO

Figure 1

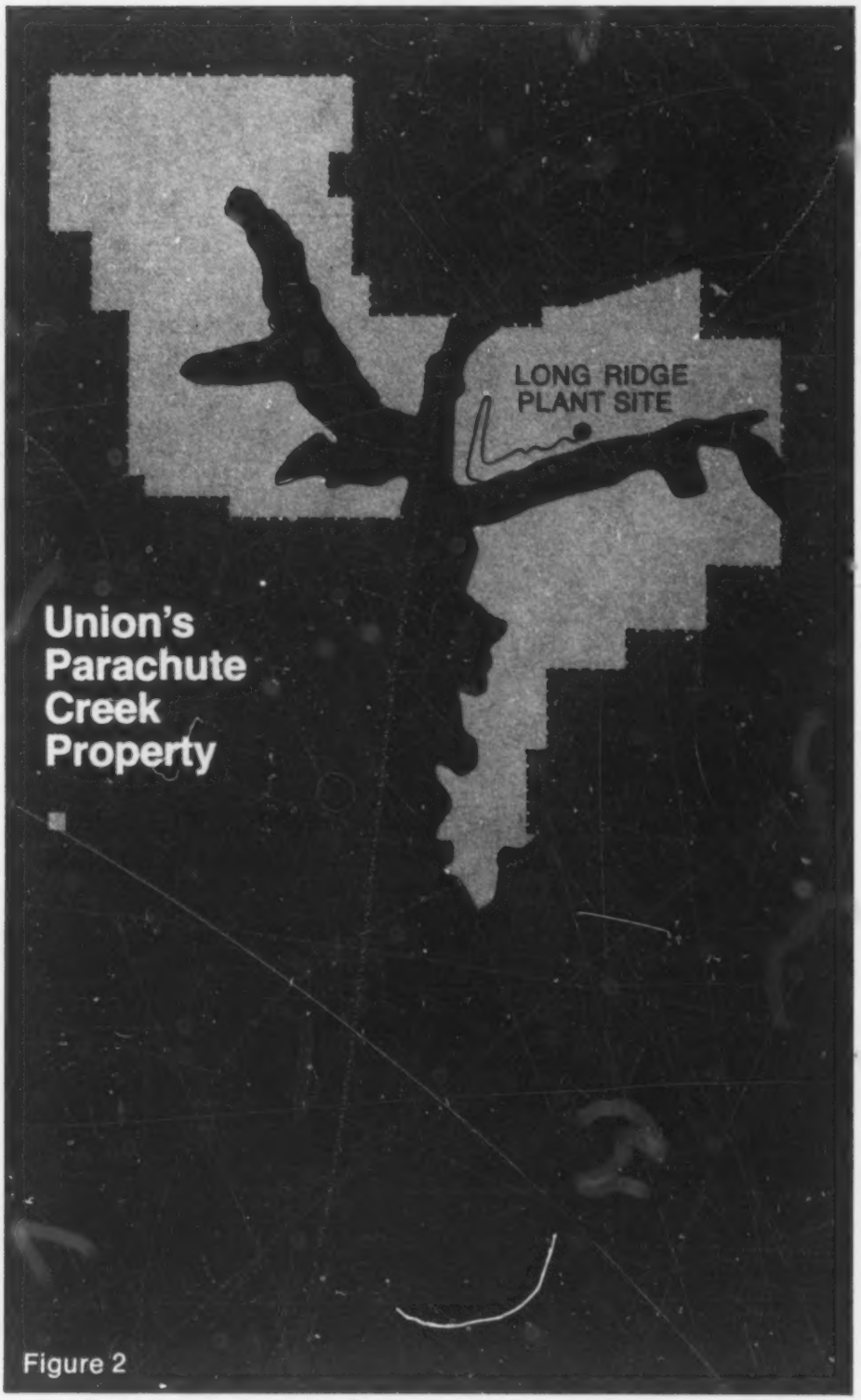

Figure 2

- Develop techniques to secure the best attainable control of environmental impacts.

Union's oil shale holdings are in the Parachute Creek area of northwest Colorado, north of Grand Valley, in Garfield County. Grand Junction, Glenwood Springs and Rifle are 58, 54 and 28 miles, respectively, from the project site. Denver is 200 miles east of Grand Valley and Salt Lake city is 320 miles northwest.

Union's property straddles Parachute Creek and its forks, which drain south into the Colorado River. These lands are highlighted in *Figure 1,* which identifies the Piceance Creek Basin, an area rich in oil shale deposits. Union's holdings, outlined in *Figure 2,* consist of approximately 20,000 acres of oil shale lands and 10,000 acres of bottom lands, including water rights and adequate acreage for deposit and vegetation of spent shale.

Shale for the experimental project will be mined from the rich Mahogany zone of the Parachute Creek geologic formation. Located about 1,000 feet above the valley floor, the underground mine will open at a portal on the south side of Long Ridge, which forms the north wall of the East Fork of Parachute Creek.

Conventional room and pillar mining will be employed, followed by underground crushing and screening to produce shale ore of suitable size for the retort. The retort and processing plant will be located on a five-acre bench site just outside the mine entrance, as shown in *Figure 3.*

Although quite simple in concept, the retort, as shown in *Figure 4,* is a large piece of machinery. Crushed ore enters the two-cylinder rock pump through two feed chutes. The 10-foot diameter pistons then force the ore upward into the retort.

Heated gas enters the top of the retort releasing kerogen contained in the shale in a hot gaseous form. The hot vapor is cooled and condensed by contact with entering cold shale being forced upward in the retort. The shale oil liquid is separated from the gas and transferred to storage

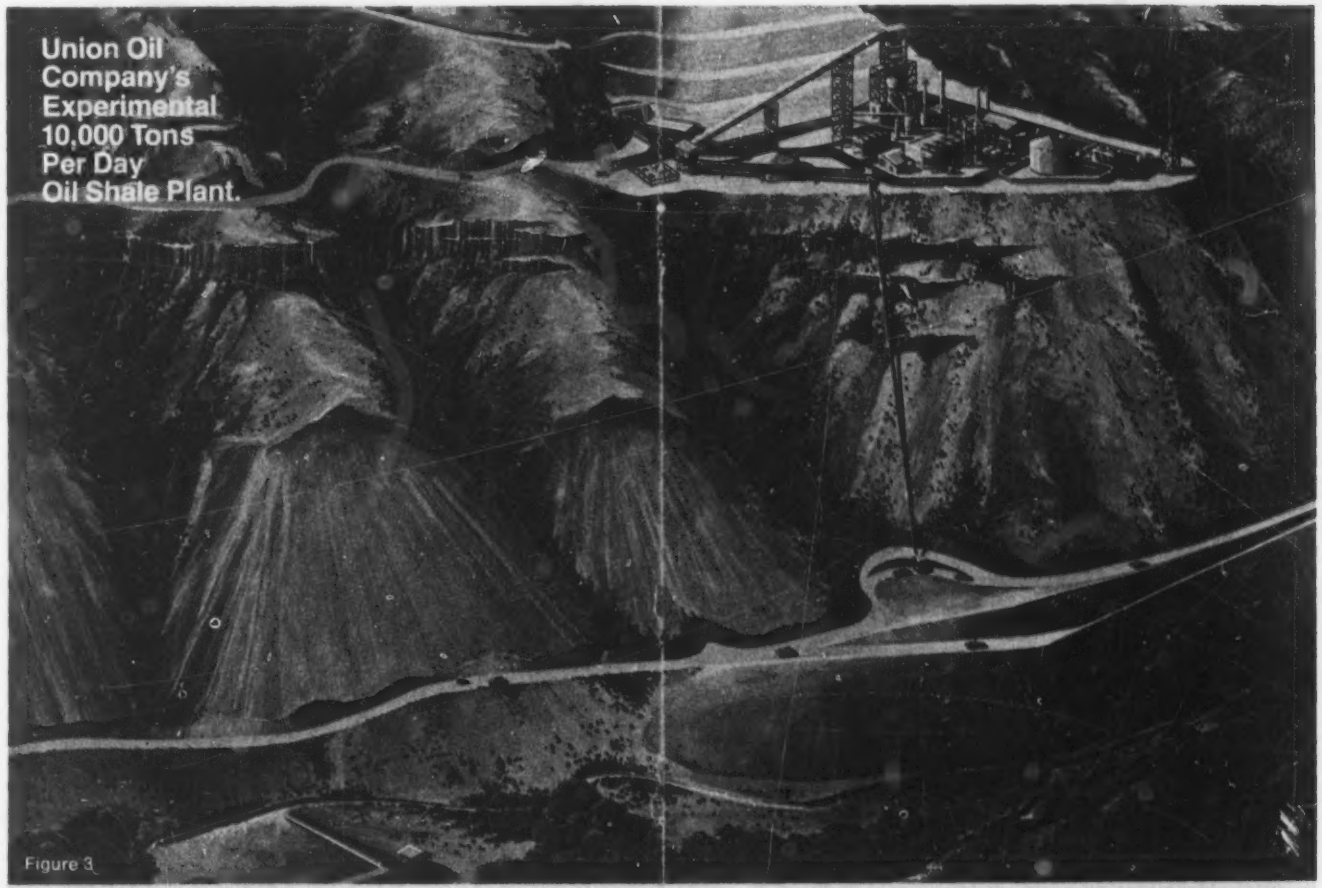

Figure 3

This sketch shows Union's experimental oil shale project during operations. Crushed and screened shale will move from the underground mine onto a five-acre bench site, then be fed into the retort to extract the shale oil. The shale oil flows into storage tanks and retorted shale moves by conveyor to the enclosed chute and down to the bottom of the valley for spreading and vegetation. A drainage pond (lower left) will capture runoff water from the spent shale deposits along with rain and snow for use in the retorting process. East Fork Parachute Creek (lower right) will be protected from recycled water and other contaminants.

as crude shale oil. The high quality gas can be burned to heat the recycle gas within the retort complex and to provide power to operate the retort equipment or could be made available for sale to a public utility.

The spent shale, with all of the oil removed, is forced up and over the edge of the retort cone and then falls by gravity through a cooling system for removal to the disposal area.

The cooled retorted shale will then be moved by conveyor belt to an enclosed chute through which it will drop into the East Fork valley floor deposit area. It will then be spread, compacted, contoured and vegetated with native plants to blend into the surrounding landscape.

Crude shale oil will be shipped by truck or rail to power plants for use in steam boilers. Union has carried out extensive tests with shale oil which show that it makes an effective boiler fuel.

If all necessary permits are secured on a timely basis, construction will begin in early 1979 with the plant operational in 1981. The plant would then operate for a period of time while extensive experimental programs are conducted and evaluated and can continue to operate while the subsequent commercial plant is being constructed.

After determining the economic and environmental feasibility of the project, Union then can determine future steps necessary for commercial development of its oil shale resources.

Union Oil—A Research Pioneer

Union Oil Company has been a pioneer in the research of shale oil production.

More than 50 years ago Union first began acquiring properties in the Parachute Creek area of Garfield County in Colorado.

The nearly 20,000 acres of oil shale lands Union owns contain some two

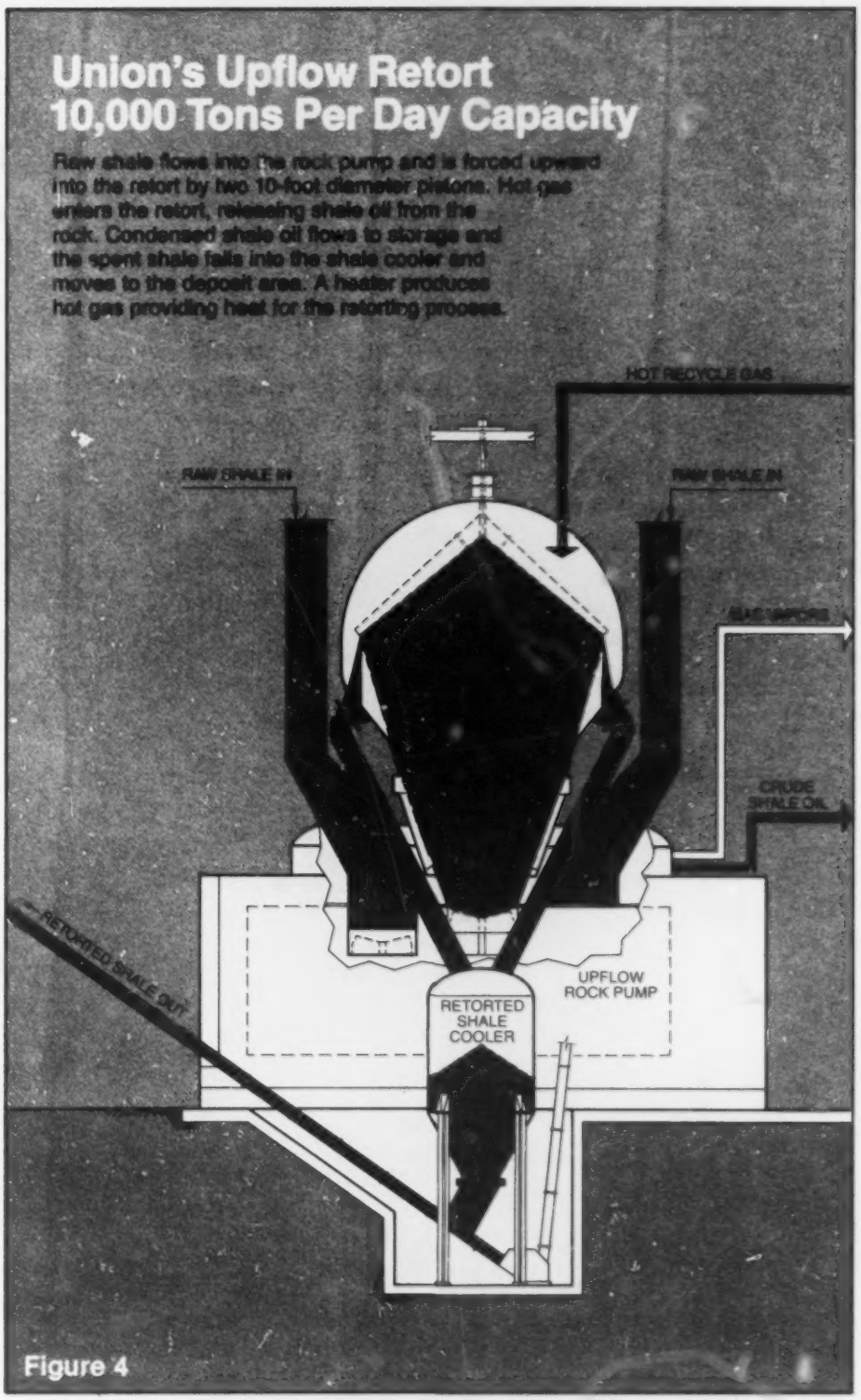
Union's Upflow Retort
10,000 Tons Per Day Capacity
Raw shale flows into the rock pump and is forced upward into the retort by two 10-foot diameter pistons. Hot gas enters the retort, releasing shale oil from the rock. Condensed shale oil flows to storage and the spent shale falls into the shale cooler and moves to the deposit area. A heater produces hot gas providing heat for the retorting process.
HOT RECYCLE GAS
RAW SHALE IN
RAW SHALE IN
CRUDE SHALE OIL
RETORTED SHALE OUT
UPFLOW ROCK PUMP
RETORTED SHALE COOLER

Figure 4

billion barrels of recoverable oil in the high-yield Mahogany zone alone. These reserves are large enough to produce 150,000 barrels of shale oil each day for at least 25 years. In addition, there are approximately two billion more barrels of reserves in adjoining lower quality zones.

Fully aware of the potential energy value of these holdings, Union's research scientists have conducted a wide variety of laboratory and field studies for more than 30 years. They have consistently sought technically, environmentally and economically feasible methods of extracting usable oils from shale.

Starting in the early 1940's and continuing into the early 1950's, Union built and operated a small, 50-ton-per-day pilot retort at its Los Angeles refinery.

From 1955 through 1958 Union built and operated a retort in Parachute Creek valley, processing up to 1,200 tons of ore per day, and producing about 800 barrels of shale oil per day. The company developed technology for treating the oil so that it could be processed in a crude oil refinery or utilized as boiler fuel in an electric generating plant. In the first commercial-scale refining of Colorado shale oil, over 13,000 barrels of shale oil were successfully processed into gasoline and other products at a refinery near Fruita, Colorado.

The low prices of world oil in the 1960's forced Union Oil to put the project on the shelf.

Following the 1973 oil embargo and the ensuing rapid rise in the world price of crude oil, Union reactivated its interest in developing a viable shale oil industry.

In addition to its own efforts, Union has engaged experienced Colorado engineering firms to evaluate the company's mining and retorting processes. This evaluation has convinced Union that it has a viable process for extracting oil from shale. With proper encouragement by the federal government and approval by the State of Colorado, Union is now

prepared to take the next steps in the development of an oil shale industry.

Air, Water and Land Impacts

Construction and operation of the experimental shale oil plant may temporarily result in some changes in air quality in the immediate operating area, located in a remote side canyon of the valley. Exhaustive studies indicate, however, that the low emission levels will not be harmful to residents of the area, to vegetation or to wildlife.

Water required in the experimental project's operations will be taken from wells on Union's property and will be recycled to minimize water requirements. Union's water rights were secured many years ago as a part of the company's long-term plan for future shale development. Project design includes detailed plans to prevent contamination of local streams and underground basins. As future retorts and process facilities are added, water also will be drawn from the Colorado River, where Union has long-established water rights.

Changes in the land surface resulting from construction of mine and processing facilities will not be visible outside the upper Parachute Creek valley. Because of the isolated location of the private property where operations are planned, alterations in the topography will be apparent only to a few visitors to the area. Steps will be taken to preserve and restore vegetation and to protect the area's wildlife and wildlife habitat. Revegetation of retorted shale has been successfully demonstrated and will be carried out on the spent shale disposal areas.

The abatement facilities necessary to reduce pollutant emissions to the maximum extent possible cannot accurately be determined from the small pilot plant operations conducted to date. As the experimental plant begins operations, Union will continuously monitor all environmental factors. The company can then install the best controls dictated by

actual operating results. This will permit development of new advanced technology as required to achieve an environmentally acceptable operation.

Social and Economic Benefits

The project will have many economic and social benefits for area communities. Total payroll of the project during construction of the experimental plant will approach $12 million annually, most of which will be spent locally.

During the operating phase of the project, it is estimated it will provide annual local taxes of about $2 million, local purchases of $2.3 million, and a payroll of some $4 million to combine to produce a basic economic contribution of more than $8 million a year to the local area. Studies indicate that each dollar usually turns over at least 2½ times before leaving an area. Thus, Union's proposed oil shale development will contribute about $20 million annually to Colorado's economy. Most of these expenditures should take place in Western Slope communities. If results of Union's operations make further development feasible, the economic contribution would grow considerably.

The project will provide about 400 jobs during the construction phase and 200 during plant operations. Many of these jobs will be filled by local residents.

Union recognizes that local communities will need to expand housing and may experience some increase in public services for a growing population. Increased revenues from local taxes should more than offset the costs of additional community expenses. In addition, the company is prepared to work closely with local officials to help solve problems before they arise.

Union will work with the area communities to plan for population growth in an effort to preserve the life style enjoyed in western Colorado.

I. Public Summary

Union Oil Company of California has submitted a proposal to the Department of Energy to construct a shale oil production facility near Parachute Creek, Garfield County, Colorado.

Union's recoverable shale reserves are estimated to exceed 1.6 billion barrels—enough to produce 50,000 barrels per day of shale oil for at least 90 years. The project is to be a commercial facility to extract shale from underground mine, produce raw shale oil in surface retorts nd upgrade it to the equivalent of a light, sweet petroleum crude oil. The upgraded shale oil can be processed to yield high percentages of jet fuel and diesel oil suitable for consumption by the Department of Defense. These and other products to meet civilian needs will reduce our country's reliance on imported crude oil.

The facility will include an underground mine, retorts for extracting oil from shale, processing facilities necessary to convert the shale oil to the equivalent of a high grade synthetic crude oil, and a syncrude pipeline. Products will initially be shipped by rail, and tank truck.

Initial production will be 10,000 barrels of syncrude per day in 1983, increasing to 50,000 barrels per day when the plant is completed in 1987. In addition to production of synthetic crude oil, 1983 capability will exist to separate up to 3,000 barrels per day of military jet aircraft fuel (JP4) and another 7,000 barrels per day of military diesel fuel based upon the syncrude. After 1987, another 7,000 barrels per day of JP4 and 3,000 barrels of additional diesel fuel will be available to meet Defense Department requirements.

Union's technical capabilities to undertake such a project have been well demonstrated. From 1955 throught 1958, Union built and operated a surface retort on its oil shale properties in Western Colorado. Using a unique upflow retort process developed by Union's scientists, this facility processed up to 1,200 tons of ore per day, and produced about 800 barrels of shale oil per day. In the first commercial refining of Colorado shale oil, over 13,000 barrels of shale oil were successfully processed into gasoline and other products at a Colorado refinery.

With the rapid rise in the price and uncertain availability of foreign crude oil in the early 1970s, Union accelerated its shale oil research and development program. Continuing improvements have been made in all phases of the program since that time.

The oil shale that will be mined to provide the primary feedstock will average 34 gallons of shale oil per ton of rock. After mining, the shale rock will be crushed and moved to surface retorts that will utilize Unions upward flow process. Within the pressurized, cone-shaped retort, recirculating gases will beat the shale, thereby decomposing the kerogen to produce crude shale oil from the rock.

Raw shale oil will be pipelined to the valley floor where it will be pretreated and hydroprocessed into a high quality synthetic crude oil that is a highly desired feedstock for most domestic refineries.

Union's project can be the first synthetic fuels plant producing commerical volumes of fuels for the Department of Defense, and can begin deliveries in 1983. Union's approach for this proposal has been to schedule construction in two phases, an initial module of

10,000 BPD capacity followed by expansion to 50,000 BPD. Construction and preproduciton excavation in a mine to feed the 50,000 BPD plant would require not less than three years, whereas a mine initially sized to feed a 10,000 BPD plant can be completed in only 1½ years.

All permits necessary for construction of the Phase I mine and retort have been issued.

Preconstruction civil work consisting of access road improvement and earth movement for site preparation for the first retort started in May, 1980 and will be completed November, 1980.

The retorting process produces a high-quality gas product, providing sufficient make gas to supply all of the energy for the plant, except for a small amount of electric power that will be used for some motors and lighting. Water for the project's initial operations will be taken from wells on Union's property, and will be recycled to minimize water consumption. Union's water rights were secured many years ago as a part of the Company's long-term shale development plans. The project is designed for zero discharge of process waste water to prevent contamination of local streams and underground basins. As additional retorts and process facilities are added, water also will be drawn from the Colorado River, where Union has long-established water rights. The plant will employ best available control technolgy to insure mimimal environmental impact as required by environmental regulations.

The work force directly employed in construction will average 2,000 persons for the years 1981 through 1987, with a peak of 4,700 in 1986. A permanent operating crew of 1,100 people will be reached in 1988. It is estimated that for each two persons employed one additional new job will be created to support them. Unemployment in the area is currently about 4 percent.

Union has proposed that the U.S. Government assist in financing the construction of the 50,000 BPD shale oil facility through the mechanism of advance payments and purchase commitment for Defense Department fuel purchases.

The contract would provide the government approximately 52 million barrels of military fuels for the Defense Department, in return for advance payments and/or "premium" payments above the market price of those fuels. The fuels would be delivered over a period of 10 years.

The Parachute Creek Shale Oil project satisfies the Department of Energy goals and the mandate of the U.S. Congress to develop domestic production of alternative fuels in the shortest practicable time. Each barrel produced would serve to reduce U.S. import demand by one barrel; and in Phase II, for each five barrels of syncrude, two barrels of refined product would go directly to meet national defense needs.

Mr. FUQUA. Thank you very much, Dr. Scott.

I think we will go ahead and hear from Mr. Chittum and then come back and ask questions.

We are happy to welcome you, Mr. Chittum, and anxiously await your testimony.

[The biographical sketch of Mr. Chittum follows:]

ROGER D. CHITTUM

Senior Vice President

Roger D. Chittum, 42, is senior vice president of Tosco Corporation in charge of Environmental Affairs.

Mr. Chittum joined Tosco in 1972 as assistant to the President, and in 1973 was elected vice president. He was promoted to senior vice president in 1981.

Prior to joining Tosco, Mr. Chittum was with the law firm of Cleary, Gottlieb, Steen and Hamilton in Washington, D. C.

A native of Wooster, Ohio, Mr. Chittum is a chemistry graduate of the College of Wooster, and received a law degree from Stanford University. He is a member of the District of Columbia Bar, the U.S. Supreme Court Bar, the State Bar of California, and the American Bar Association.

STATEMENT OF ROGER D. CHITTUM, SENIOR VICE PRESIDENT, TOSCO CORP., WASHINGTON, D.C.

Mr. CHITTUM. Thank you, Mr. Chairman.

My name is Roger Chittum. I am a senior vice president of Tosco Corp., and I head the environmental affairs department. I am responsible for permits, environmental research and development, environmental design review, compliance management systems, and environmental oversight at all of Tosco's operations, including the Colony shale oil project.

I am pleased to have the opportunity to share with the members of this subcommittee the results of over 16 years of research by Tosco on the environmental and health aspects of oil shale development. These are important issues, and Tosco has worked since 1965 to insure that the Colony project will be a demonstration of the highest standards of environmental compliance and socioeconomic planning which future commercial projects can follow with confidence.

First, however, it is usually necessary to describe Tosco; and I will do so very briefly.

Tosco was founded in 1955 as the Oil Shale Corp. to develop commercial technology for the recovery of oil and gas from oil shale. Since that time, the company has grown to become a diversified company engaged in refining and marketing of petroleum products while continuing the development of clean fuels from oil shale, coke, and other solid materials.

The company is the Nation's second largest independent refiner of gasoline, with refineries located at Bakersfield and Avon, Calif.; El Dorado, Ark.; and Duncan, Okla.

Our total refining capacity is now about 260,000 barrels per day.

The Tosco II retorting process which will be used in the Colony project is proprietary technology developed by Tosco. Tosco maintains an extensive research and pilot plant facility near Golden, Colo., where we are continuing to develop advanced processes to recover fuels and other products from oil shale, coal, and other solid materials.

Since Tosco organized the original Colony oil shale venture in 1964, Tosco's technical and management staffs have continuously played a key role in all aspects of the Colony venture work.

From 1966 through 1968, a period during which some of the most significant technological advances were made in the process and oil shale mining techniques, Tosco was the operator of the Colony mine and semiworks retorting plant.

From 1970 through 1974, Tosco participated in the supervision and coordination of the commercial design studies on retorting, oil upgrading, mining, spent shale disposal, and environmental and socioeconomic planning which have led to a detailed understanding of all these facets of a commercial facility.

The Colony project has taken a careful and thorough approach to environmental issues and is strongly committed to environmentally sound development.

Tosco took the lead in the design of the environmental monitoring program and the preparation of the environmental impact analysis for the project in the early 1970's.

Major environmental tests, demonstrations, and studies, starting as early as 1965, have been managed as an integral part of developing and demonstrating the mining, retorting, and reclamation processes.

Based on 5 years of detailed analysis, a final environmental impact statement for the project has been issued by the Bureau of Land Management.

Additional outside scrutiny of environmental impacts has been provided by Federal, State, and local permit-granting authorities. The application and review processes for all major permits required for initial construction have been completed and the permits granted.

The committee has asked that we address the procedures we have deemed necessary to assure environmental compliance by Colony. I shall address these in four major headings—air quality, water quality, solid waste disposal, and health effects.

Colony first began detailed air quality monitoring and impact analyses in 1970 to support its applications for air permits. These efforts culminated in the issuance of a Federal PSD permit in July 1979.

At that time, EPA Regional Administrator Alan Merson said: "Colony, in short, has passed our most stringent air quality tests and has committed itself to using best available control technology and to comprehensive monitoring once operation begins."

The Colorado Department of Health has also issued air permits.

Sophisticated analytical techniques were used in monitoring the pilot plant operations to measure the release of all elements and biologically active organics in the process particulate emissions. Trace metal elements were found to be equivalent to the Earth's crustal averages, and concentrations of biologically active organics, including polycyclic aromatic hydrocarbons, were found to be lower than the levels in common soils.

To minimize air emissions and insure compliance with all air quality standards, the Colony project incorporates an integrated program of control hardware, operating procedures, ambient monitoring, and source testing.

An integral part of the PSD permit process was EPA's source-by-source review of air emissions controls to insure that the best available control technology was selected.

A wide variety of pollution control systems was adopted to reduce air emissions from the process. In addition, the Colony project developers voluntarily are incurring an incremental cost of $100 to $200 million in order to locate the plantsite on the top of a mesa overlooking the mine rather than in the valley location where there might be some threat of damage to local air quality.

Selection of these systems and determination of the efficiencies specified for each were based on engineering analyses, source sampling, and testing of devices at the semiworks plant and the Tosco pilot plant and, of course, on the commitments of vendors of the equipment.

To insure proper equipment performance, Colony is committed to a comprehensive emissions testing and reporting program during plant operation. As part of the air pollution control program for

Colony, continuous ambient monitoring will occur to insure the acceptability of plant operations.

Turning to water quality, the Colony facility is designed so that all waste water will be treated and internally recycled and reused. Process and produced water, as well as sewage and maintenance water, will be treated and used in the plant for spent shale handling, dust control, irrigation, and other uses.

The design of the Colony facility also provides for the containment and reuse of runoff water from the spent shale embankment.

Water quality at the project site has been monitored to establish baseline levels for evaluating the effects of facility construction and operation.

The solid waste, which will be produced in largest volume by the Colony project, will be spent shale. The results of tests performed on Tosco II spent shale samples have demonstrated that Colony spent shale is not a hazardous waste under EPA-established criteria.

A spent shale disposal and reclamation plan, designed to protect surface and groundwater quality and to establish acceptable postreclamation uses of the area over the short and long term, has been developed by Tosco and Colony after more than 16 years of field testing, demonstration, and research.

The Colony plan is based upon data derived from its own activities and upon the results of studies conducted at other sites by a number of Government agencies.

The Colony plan will provide for disposal of the spent shale in a stable embankment, which will insure both the integrity of the pile in terms of slippage and slumping and control surface erosion to limit potential degradation of downstream waters.

It will provide for compaction to limit permeability and leaching from the disposal pile.

It will establish a permanent, self-sustaining vegetation cover which will blend with existing native vegetation and support similar wildlife and land uses over the long term.

Revegetation studies carried out at the semiworks plant and at offsite facilities over the past 16 years have resulted in the development of a highly successful technique for revegetating spent shale.

The commercial plant revegetation procedure has been demonstrated in spent shale embankments constructed on the Colony property at various elevations and exposures. As a result of the demonstration program, we are confident that the revegetation process will be successful. The program has been extensively reviewed and approved by the Colorado Mine Land Reclamation Board.

The Colony facility will also produce certain forms of waste which are similar to those resulting from petroleum refining. These wastes will be disposed of in accordance with the requirements of the Resource Conservation and Recovery Act and State regulations.

Finally, on health effects, extensive tests conducted by Tosco and others, including lifetime animal tests, have demonstrated that the severely hydrotreated shale oil which the Colony facility will produce will present less of a health hazard than the conventional petroleum crude which it will replace.

The tests have demonstrated that crude shale oil, before hydrotreating, is equivalent in its physical, chemical, and biological properties to refinery intermediate streams generated from conventional petroleum.

The hydrotreating performed at the Colony facility before the oil is transmitted to the refiner will significantly reduce the biological activity to values less than those associated with presently used petroleum crudes.

Chemical analyses of the materials tested have failed to detect any inherently toxic chemical compounds not commonly found in petroleum-derived materials.

These general conclusions are consistent with the findings of a number of epidemiological studies which have been performed on oil shale workers. Such studies, going back to the mid-19th century, demonstrate that the cancer incidence of workers in shale oil facilities is identical to that of the contemporaneous general population.

Mr. Chairman, I hope that this brief discussion will be of help to the committee in its examination of the environmental procedures necessary to design, construct, and operate an oil shale plant. Our experience indicates that a commercial oil shale facility can be developed and operated in a manner which meets environmental and health requirements, provided that the developer accords priority to that goal. We have attempted to do so with the Colony project, and we believe that we have succeeded.

I would be happy to try to answer questions.

[The prepared statement of Mr. Chittum follows:]

Mr. Chairmen and members of the Subcommittee: My name is Roger D. Chittum. I am Senior Vice President of Tosco Corporation. I head the Environmental Affairs Department which is responsible for permits, environmental research and development, environmental design review, compliance management systems, and oversight at all of Tosco's operations, including the Colony Shale Oil Project. I am pleased to have the opportunity to share with the members of this Committee the results of over sixteen years of research by Tosco on the environmental and health aspects of oil shale development. Tosco has worked since 1965 to insure that the Colony Project will be a demonstration of the highest standards of environmental compliance and socioeconomic planning which future commercial projects can follow with confidence.

Tosco was founded in 1955 to develop commercial technology for the recovery of oil, gas, and other products from oil shale. Since that time, the company has grown to become a diversified energy company engaged in refining and marketing of petroleum products and the development of clean fuels from oil shale, coke, and other solid materials. The company is the Nation's second largest independent refiner of gasoline, with refineries located at Bakersfield and Avon, California, El Dorado, Arkansas, and Duncan, Oklahoma and a system-wide capacity of more than 260,000 B/D.

The TOSCO II retorting which will be used in the Colony Project is proprietary technology developed by Tosco. Tosco maintains an extensive research and pilot plant facility at Golden, Colorado, where we are continuing to develop advanced processes to recover fuels and other products from oil shale, coal, and other solid materials.

Since Tosco formed the original Colony oil shale venture in 1964, Tosco's technical and management staffs have continuously played a key role in all aspects of the Colony venture work. From 1966 through 1968, a period during which the most significant technological advances were made in the TOSCO II process and oil shale mining techniques, Tosco was the operator of the Colony mine and semi-works retorting plant. From 1970 through 1974, Tosco participated in the supervision and coordination of the commercial design studies on retorting, oil upgrading, mining, spent shale disposal and environmental and socioeconomic planning which have led to a detailed understanding of all facets of a commercial facility.

The Colony Project is located in Garfield County, Colorado, near the town of Parachute. The current Colony owners, Tosco and Exxon Corporation, are in the process of building a full-scale commercial shale oil complex which will produce 48,300 barrels per stream day of hydrotreated shale oil and other products. The complex will employ underground mining, surface crushing and retorting, and on site hydrotreating of crude shale oil. The hydrotreated shale oil produced by the Project will be a premium refinery feestock for processing into jet fuel, high octane unleaded gasoline, diesel fuel, and other light products. The products will be particularly valuable in meeting the Nation's needs for military and civilian transportation fuels.

The Colony Project has taken a careful and thorough approach to environmental issues and is strongly committed to environmentally sound development. Tosco took the lead in the design of the environmental monitoring program and the preparation of the environmental monitoring program and the preparation of the environmental impact analysis for the Project. Major environmental tests, demonstrations and studies, starting as early as 1965, have been managed as an integral part of developing and demonstrating the mining, retorting, and reclamation processes. Based on five years of detailed analysis, a Final Environmental Impact Statement for the Project has been issued by the Bureau of Land Management.

Additional outside scrutiny of environmental impacts has been provided by federal, state and local permit-granting authorities. The application and review processes for all major permits required for initial construction has been completed and the permits granted.

The Committee has asked that we address the procedures we have deemed necessary to assure environmental compliance by Colony. I shall do so under four major headings: air quality, water quality, disposal of solid wastes and health effects.

AIR QUALITY

Colony first began detailed air quality monitoring and impact analyses in 1970 to support its applications for permits. These efforts culminated in the issuance of a PSD permit in July 1979. At the time of its issuance, EPA Regional Administrator Alan Merson said, "Colony, in short, has passed our most stringent air quality tests, and has committed itself to using best available control technology and to comprehensive monitoring once operation begins." Friends of the Earth spokesman Kevin Markey characterized the EPA's review as "hard hitting and well done." The Colorado Department of Health, which enforces certain air pollution control standards more stringent than EPA PSD standards, has also issued permits for the Colony Project.

Sophisticated analytical techniques were used in monitoring the pilot plant operations to measure the release of all elements and biologically active organics in process particulates. Trace metal elements were found to be equivalent to the earth's crustal averages and concentrates of biologically active organics, including polycyclic aromatic hydrocarbons, were found to be lower than the levels present in common soils.

To minimize air emissions and ensure compliance with all air quality standards, the Colony Project incorporates an integrated program of control hardware, operating procedures, ambient monitoring, and source testing. An integral part of the PSD permit process was EPA's source-by-source review of air emissions controls to ensure that the "Best Available Control Technology" (BACT) was selected. A wide variety of pollution control systems was adopted to reduce air emissions from the process. In addition, the Colony Project developers have voluntarily incurred an incremental cost of $100 million to $200 million in order to locate the plant site on the top of a mesa overlooking the mine, rather than at a lower level, in order to protect local air quality.

Selection of these systems and determination of the efficiencies specified for each were based on engineering analyses, source sampling and testing of devices at the semi-works plant and Tosco pilot plant, and on the commitments of vendors.

To ensure proper equipment performance, Colony is committed to a comprehensive emissions testing and reporting program during plant operation. As part of the air pollution control program for Colony, continuous ambient monitoring will occur to ensure the acceptability of plant operations. The monitoring program, to be approved by EPA and the State, will include: (1) five years of continuous monitoring of sulfur dioxide, total particulates, particulate size, and nitrogen oxides; (2) five years of meteorological data collection; and (3) four years of visibility data collection.

WATER QUALITY

The Colony facility is designed so that all wastewater will be treated and internally recycled and reused. Process and produced water as well as sewage and maintenance water will be treated and used in the plant for spent shale handling, dust control, irrigation and other uses. The design of the Colony facility also provides for the containment and reuse of runoff water from the spent shale embankment. Water quality at the project site has been monitored to establish baseline levels for evaluating the effects of facility construction and operation.

DISPOSAL OF SOLID WASTES

The solid waste which will be produced in largest volume by the Colony Project will be spent shale. The results of tests performed on TOSCO II spent shale samples have demonstrated that Colony spent shale is not a hazardous waste under EPA established criteria.

A spent shale disposal and reclamation plan designed to protect surface and groundwater quality and to established acceptable post-reclamation uses of the area over the short and long term has been developed by Tosco and Colony after more than 16 years of field testing, demonstration, and extensive research. The Colony plan is based upon data derived from its own activities and upon the results of studies conducted at other sites by a number of government agencies.

The Colony plan will:

Provide for disposal of the spent shale in a stable embankment, and will ensure both the integrity of the pile in terms of slippage and slumping, and control surface erosion to limit potential degradation of downstream waters.

Provide for compaction to limit permeability and leaching from the disposal pile.

Establish a permanent, self-sustaining vegetation cover which will blend with existing native vegetation and support similar wildlife and land uses over the long term.

Revegetation studies carried out at the semi-works plant and at offsite facilities over the past 16 years have resulted in the development of highly successful techniques for revegetating spent shale. The principal problems to be solved at the start of the revegetation programs were: providing the spent shale with two nutrients (nitrogen and phosphorous); overcoming its high soluble salt content; and overcoming the low water infiltration rates of compacted embankments.

All of these problems were successfully resolved by using conventional horticultural techniques. The nutrient problem was solved by addition of fertilizer rich in nitrogen and phosphorous. The soluble salt problem was solved by extensive watering of the embankment prior to seeding in order to leach salts to a depth below the root zone of the selected plants, or by planting of native salt-tolerant species. The problem of low water infiltration rates was solved by covering the spent shale embankment with topsoil before seeding.

The commercial plant revegetation procedure has been demonstrated in spent shale embankments constructed on the Colony property at various elevations and exposures. As a result of the demonstration program, we are confident that the revegetation process will be successful.

The Colony facility will also produce certain forms of waste which are similar to those resulting from petroleum refining. These wastes will be disposed of in accordance with the requirements of the Resource Conservation and Recovery Act.

HEALTH EFFECTS

Extensive tests conducted by Tosco and others, including lifetime animals tests, have demonstrated that the severely hydrotreated shale oil which the Colony facility will produce will present less of a health hazard than the conventional petroleum crude which it will replace. The tests have demonstrated that crude shale oil—before hydrotreating—is equivalent in its physical, chemical and biological properties to refinery intermediate streams. The hydrotreating performed at the Colony facility before the oil is transmitted to the refiner will significantly reduce the biological activity to values less than those associated with presently used petroleum crudes. Chemical analyses of the materials tested have failed to defect any inherently toxic chemical compounds not commonly found in petroleum derived materials.

These general conclusions are consistent with the findings of a number of epidemiological studies which have been performed on oil shale workers. Such studies, going back to the mid 19th century, demonstrated that the cancer incidence of workers in shale oil facilities is identical to that of the contemporaneous general population.

Mr. Chairman, I hope that this brief discussion will be of help to the Committee in its examination of the environmental procedures necessary to design, construct and operate an oil shale plant. Our experience indicates that a commercial oil shale facility can be developed and operated in a manner which meets environmental and health requirements, provided that the developer accords priority to that goal. We have attempted to do so with the Colony Project, and we believe that we have succeeded.

Tosco Corporation

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August 6, 1981

THE COLONY SHALE OIL PROJECT

FACT SHEET

Highlights

In 1985 the Colony Project, America's first commercial oil shale project, will begin production on the Western Slope of Colorado, using a process developed and perfected over the last 25 years by Tosco Corporation, a pioneer in oil shale technology and the nation's second largest independent gasoline producer.

- The Colony Project will produce 48,000 barrels per day of upgraded shale oil, a prime source of liquid fuel for America's defense and transportation needs.

- The TOSCO II process has been extensively field tested in a semi-works plant on the Colony site over a period of 7 years (see exhibit 12).

- The Colony Project will produce an affordable substitute for conventional crude oil. The high-grade refinery feedstock produced at Colony is commercially viable at prices competitive with the price of Wyoming sweet (low sulfur) crude.

- The Colony Project has been designed to comply with all applicable environmental standards and requirements. All the major permits needed for construction have been received. The plant will operate on a zero wastewater discharge basis; all wastewater generated at Colony will be treated and reused. Colony is the first shale oil project to comply with the stringent Prevention of Significant Deterioration ("PSD") requirements under the Clean Air Act. In addition, Colony's comprehensive socioeconomic impact mitigation program is unprecedented in terms of its scope and the level of investment.

• In response to the anticipated population impact associated with the project, Colony is carrying out a program of assistance to existing communities and is developing a model new community, known as Battlement Mesa, designed for a total population of 20,000 to 25,000 (more than twice the total population directly and indirectly associated with the project).

The Battlement Mesa new community will provide a full range of residential options as well as schools, shops, community centers, fire and police protection and other municipal services and facilities. Battlement Mesa will not be a company town; it will be open to all who wish to live there. While not designed to be profit-making, the community is being privately developed in a manner similar to a commercial real estate development in order to maximize the flexibility and responsiveness to actual market need.

• Colony has budgeted approximately $65 million for socio-economic mitigation in 1981 alone and the program anticipates total expenditures of more than $350 million over the life of the project for monitoring, planning, and community development associated with the new community of Battlement Mesa and Colony's program of assistance to existing communities.

• The Colony Project will provide a major new source of tax revenues to Colorado and existing local governments on the Western Slope. Over $43 million in taxes will be paid to state and local governments during the construction phase alone. Once the project becomes operational, state taxes will average almost $20 million per year, and county and municipal taxes more than $35 million per year, at current rates. Over its 20-year life the project will generate a total of more than $866 million in state, county and municipal taxes.

• In addition to substantial public revenues, the Colony Project will generate significant new investment and employment throughout the entire U.S. economy.

Project Description

• The Colony Project will be the first full-scale commercial shale oil production facility in the United States.

- Colony will use Tosco Corporation's proprietary surface retorting technology--the TOSCO II Process--to extract the shale oil from the rock. The TOSCO II Process has been developed and perfected by Tosco Corporation over the past 25 years and has been extensively tested in a 1,000 ton-per-day semiworks plant on the Colony site (see exhibit 12).

- Colony is located on a privately owned, 5,480 acre oil shale tract 15 miles north of the town of Parachute in northwestern Colorado (see exhibit 7). Tosco estimates that the deposit contains 634 million recoverable barrels of shale oil.

- Upgraded shale oil produced at Colony will be of a comparable quality to the best sweet crudes, such as premium (low sulfur) Wyoming crude oil. It is an excellent refinery feedstock and is well suited for the production of jet fuel and gasoline for military and civilian transportation uses.

- The plant is designed for a useful life of 20 years, although the reserves would support subsequent expanded operations.

- Tosco owns a 40-percent interest in the project, which is held by its wholly-owned subsidiary, The Oil Shale Corporation. The remaining 60-percent is owned by Exxon Corporation.

Mining

- Shale will be mined underground from the Mahogany Zone. The rock in the 60' high mining section of the Mahogany Zone yields an average of 34.7 gallons of oil per ton of shale.

- Because the Mahogany zone is exposed to the surface at the Colony site, entrance to the mine will be achieved laterally through adits opening onto the mine bench (see exhibit 15).

- Shale will be mined by the conventional room and pillar method. The rooms will be approximately 60 feet wide by 60 feet high (see exhibit 14).

- The large underground mining spaces will permit Colony to use heavy mining equipment of the type commonly used in surface mines, such as 85-ton diesel trucks and 12-cubic yard loaders (see exhibit 14).

- The mine will produce 66,000 tons of ore per day, which will be hauled to the surface for crushing and retorting (see exhibits 15 and 16).

- Colony has already operated a large prototype mine at the site, from which more than 1.2 million tons of ore were extracted in the late 1960s and early 1970s.

Retorting and Upgrading

After mining and crushing, the shale will be fed to the six, 11,000 ton-per-day TOSCO II surface retorts operating in parallel (see exhibit 17).

- TOSCO II retorts are designed to use continuously circulating hot ceramic balls to recover the shale oil. Half-inch balls which have been heated to about 1,200 degrees F are mixed with preheated crushed shale in a rotating drum. Heat from the balls converts kerogen, the organic material embedded in the rock, into shale oil which, at the high temperatures involved, is in vapor form. After leaving the drum, the balls, now at about 900 degrees F, are separated from the spent shale by a screening device, and then reheated for use in processing additional shale.

- After the shale oil vapor leaves the Tosco retorts, it is cooled and condensed. It is then upgraded on-site, a process by which nitrogen, sulfur and other impurities are removed from the raw shale oil. The nitrogen is converted to ammonia, which is a valuable fertilizer by-product. The sulfur can be used in rubber manufacture, chemicals, and for fertilizer uses (see exhibit 17).

- The plant's daily production capacity is 48,000 barrels per stream day of hydrotreated shale oil (about 40 degrees API); 170 tons of sulfur; and 150 tons of nitrogen in the form of agricultural grade ammonia.

- The plant's water requirements will be met primarily from Colorado River water rights. In an October 1979 study the Colorado Department of Natural Resources concluded that there is sufficient water in the Upper Colorado River Basin to support a synfuels industry of approximately 1.5 million barrels per day without significantly affecting other consumptive uses.

- The upgraded shale oil will be transported by a new pipeline link from the project site to regional and national product pipeline networks, through which it can flow to refineries in the West, Midwest and East.

Reclamation

- The Colony spent shale reclamation program represents the culmination of 15 years of field testing, demonstrations and research by Tosco and Colony. The program is designed to:

  -Provide long-term stability to the spent shale pile;

  -Avoid leaching of salts and other dissolved solids from the pile; and

  -Establish a permanent, self-sustaining vegetation cover which will blend with existing native vegetation and support local wildlife.

- After the oil has been extracted from the shale in the retort, the hot spent shale, a dark grey, gravelly substance, is cooled, moistened and conveyed to the disposal embankment.

- The spent shale will be compacted and contoured into a terraced, revegetated area which will blend with the natural surroundings on the site and will provide an effective habitat for wildlife.

- The spent shale will be covered with at least 18 inches of talus and topsoil. It will then be fertilized and seeded with plants selected on the basis of Colony's extensive research program. Irrigation will be provided as long as needed to assure stable plant growth (see exhibit 18).

Environmental Protection and Socioeconomic Planning

- The Colony Project has obtained every major environmental permit needed for construction of the facility.

- Over $8 million has been spent on environmental studies, socioeconomic planning and community development for the Colony Project between 1965 and 1980.

- Key permits and approvals granted include:

  -a final Environmental Impact Statement (EIS) covering the entire project published in June 1977, and based on a 20-volume Environmental Impact Assessment submitted by Colony in 1974

  -the first Prevention of Significant Deterioration (PSD) permit ever issued by the Environmental Protection Agency for a shale oil project under the rigorous PSD program of the Clean Air Act

  -a permit covering mining, construction, reclamation, and closure activities issued in October 1980 by the Colorado Mined Land Reclamation Board (MLRB)

- Colony has been designed as a zero discharge facility; all wastewater will be treated and reused on-site.

- For more than a decade, Colony has been acquiring land on a site near Parachute for a comprehensive model new community to accommodate the population increase associated with the Colony Project.

- Colony's objective in developing a comprehensive master plan for Battlement Mesa is to avoid unplanned, uncontrolled boom town development.

- Battlement Mesa has been designed for a population of 20,000 to 25,000, more than twice the total population directly and indirectly associated with the Colony Project.

- Battlement Mesa is an open community, not a company town, and is being developed as an independent, self-sufficient real estate development. The new community, which is not designed to be profit-making, is being built for the purpose of mitigating the adverse impacts of the project and insuring the timely provision of housing and municipal services and facilities.

- The plan for Battlement Mesa encompasses housing and a full range of municipal and commercial services and facilities, including a commercial center, eight schools, eight churches, parks and open spaces, recreational facilities, a public safety building, office buildings, a golf course and other amenities.

INDEX OF EXHIBITS

Exhibit Number	Description of Contents
1	Map Showing the Location of Oil Shale Deposits in Colorado, Utah and Wyoming
2	Map Showing Location of Piceance Creek Basin
3	Map Showing Three-County Region of Impact, Colony Shale Oil Project
4	Map Showing Major Transportation Routes in the Area Adjacent to the Colony Project
5	Map Showing Land Ownership for the Area Adjacent to the Colony Project
6	Geologic Cross Section of Colony Project Site
7	Overview Rendering of the Colony Project Site
8	Overview Rendering of the Colony Project -- South End Terminal/Staging Area and Battlement Mesa
9	Map of Battlement Mesa
10	Overview Rendering of the Colony Project -- North End Mining, Processing and Disposal Facilities
11	Photograph of Colony Shale Oil Project's Semi-works Plant and Pilot Mine
12	Photograph of the TOSCO II Semi-works Retort
13	Rendering of the Commercial Mine Bench and Semi-works

14 Photograph of Underground Room and Pillar Mining

15 Rendering of the Mine Bench with Primary Crusher

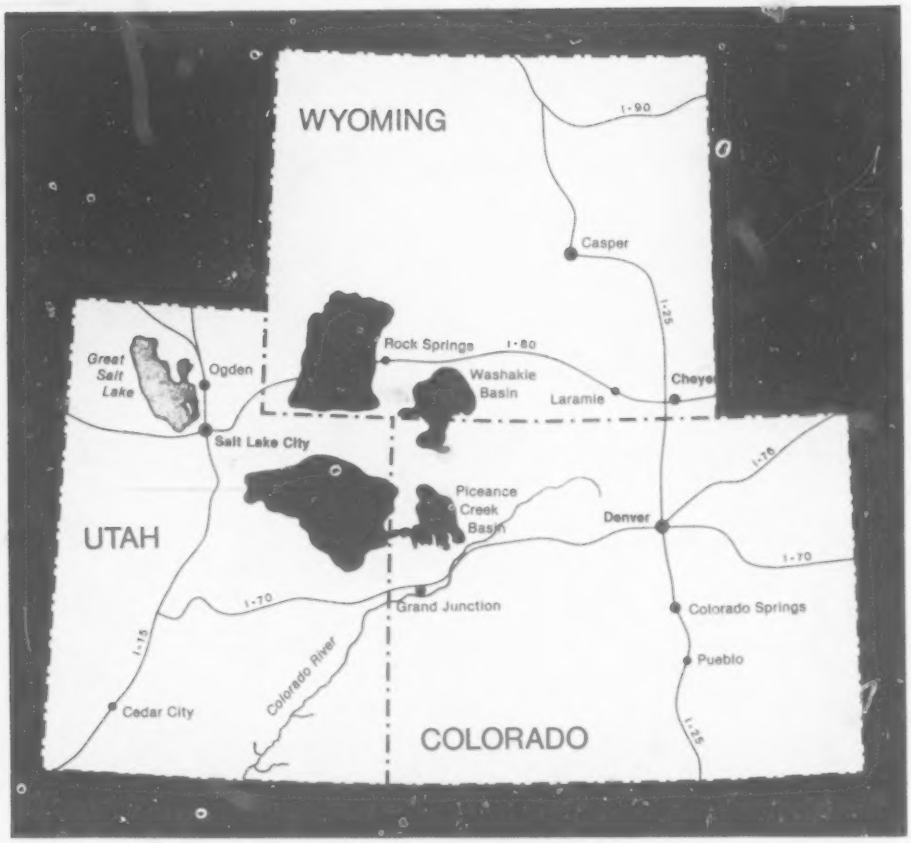
16 Rendering of Secondary Crushing and Retorting Facilities

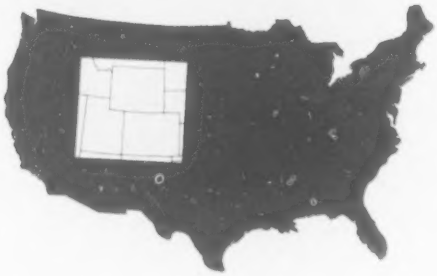
17 Rendering of Retorting and Hydrotreating Facilities

18 Photograph of Revegetation Test Plot

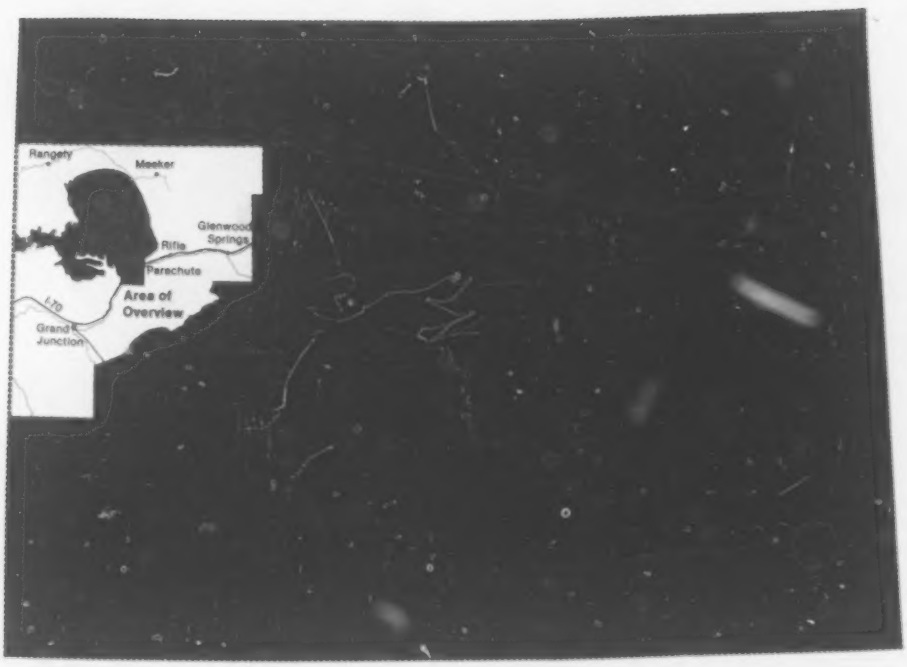
19 Rendering of Terminal/Staging Area

Western Oil Shale Deposits

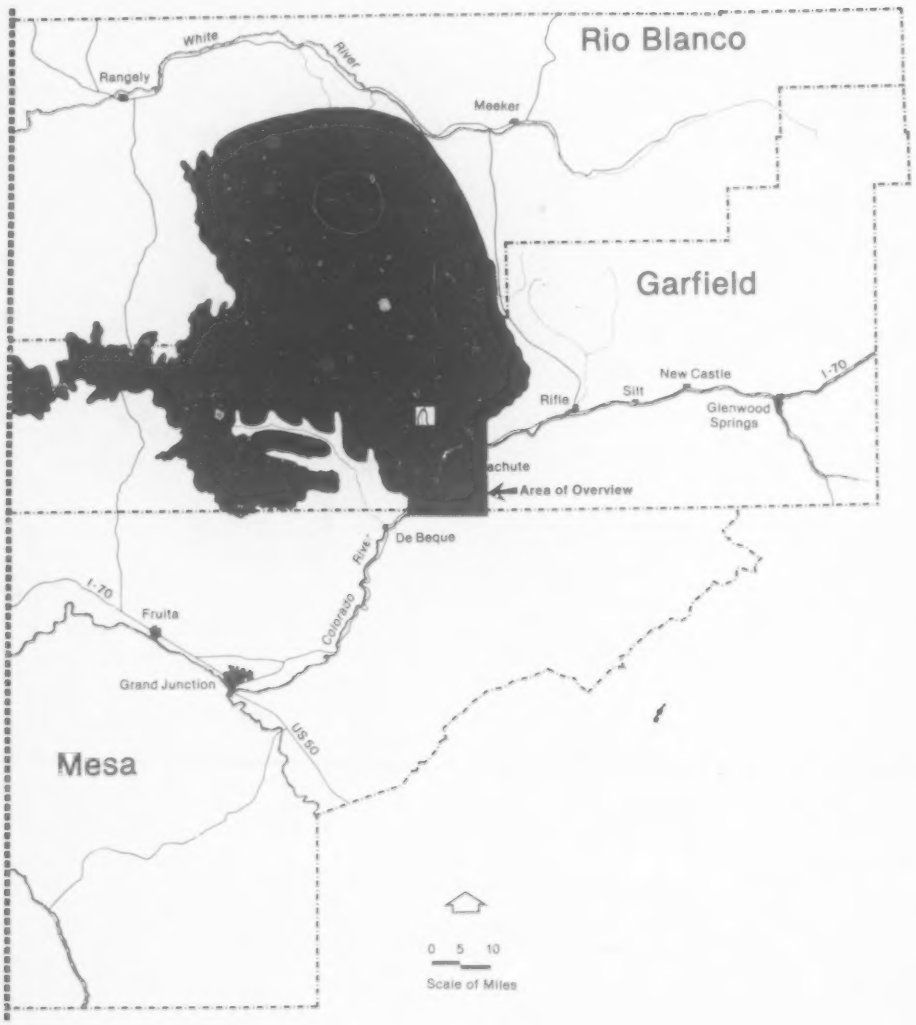




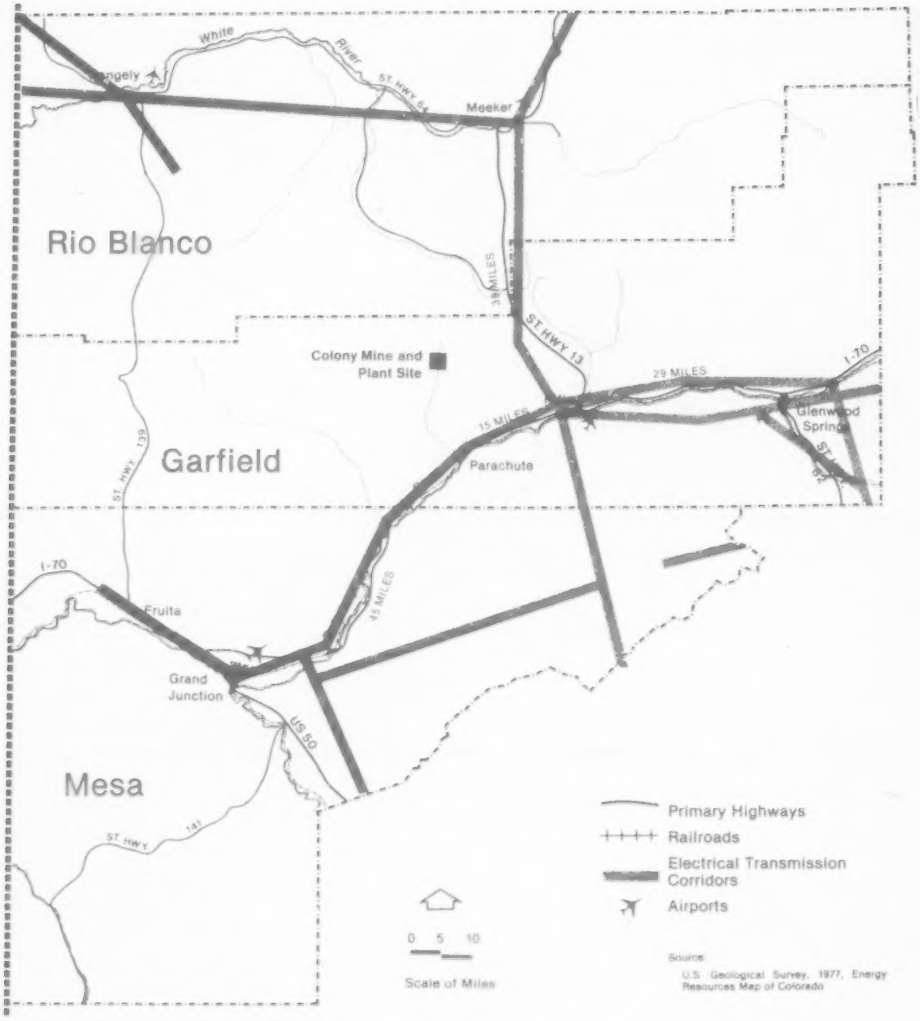
Colorado


Rangely
Meeker
Glenwood Springs
Rifle
Parachute
Area of Overview
I-70
Grand Junction

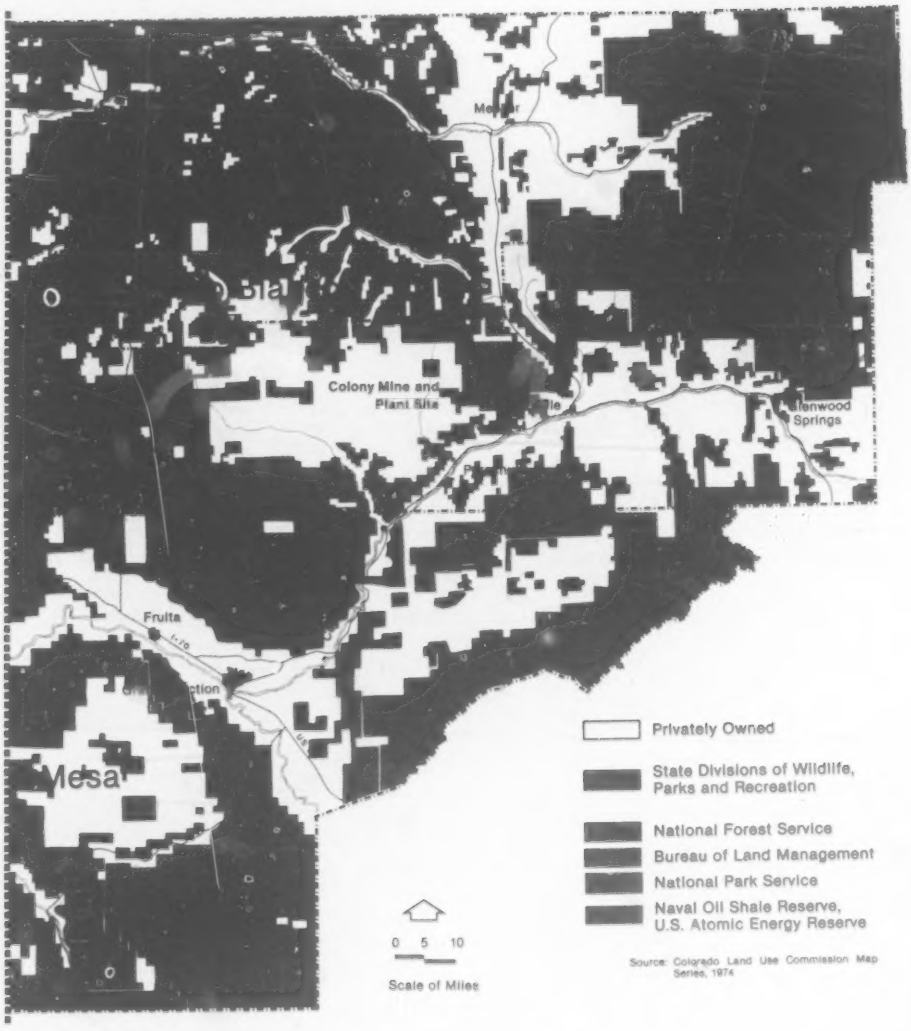
Three-County Region of Impact



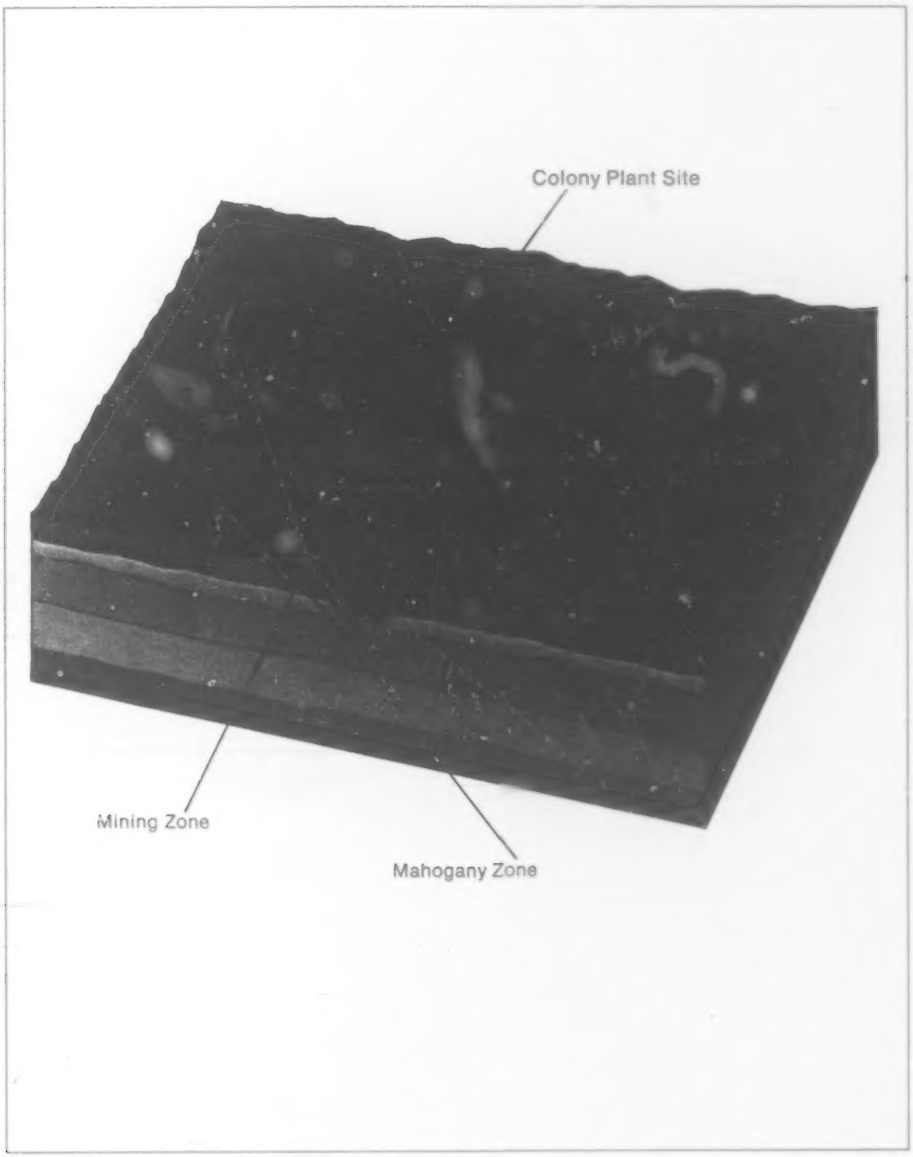
Transportation



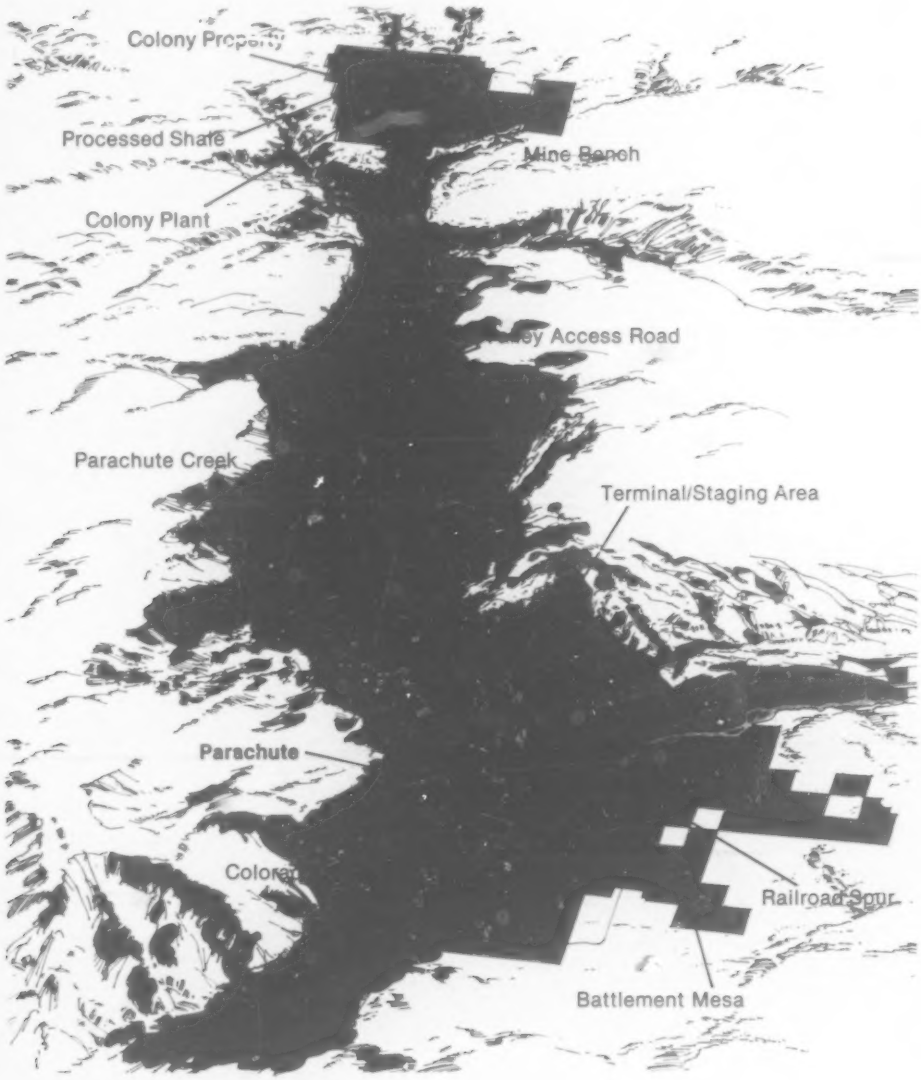
Land Ownership



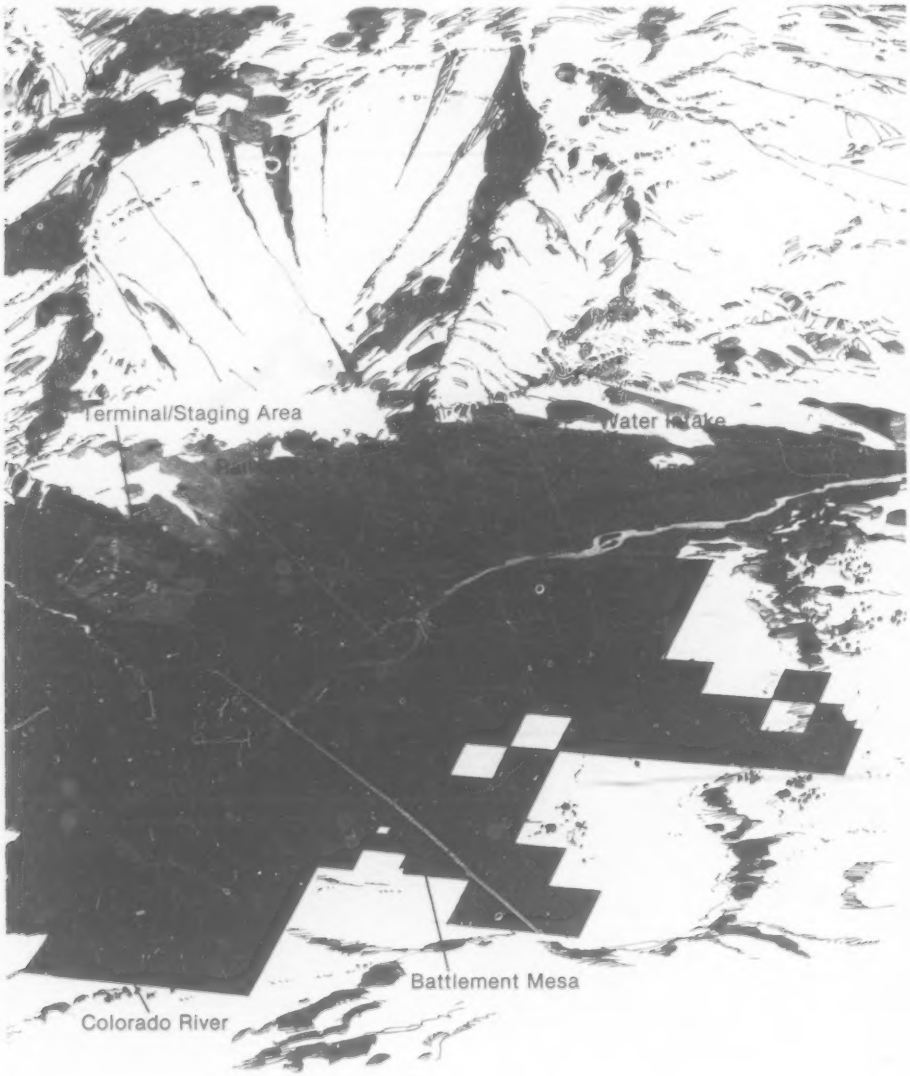
Geologic Cross Section at Project Site



Overview of Project Site

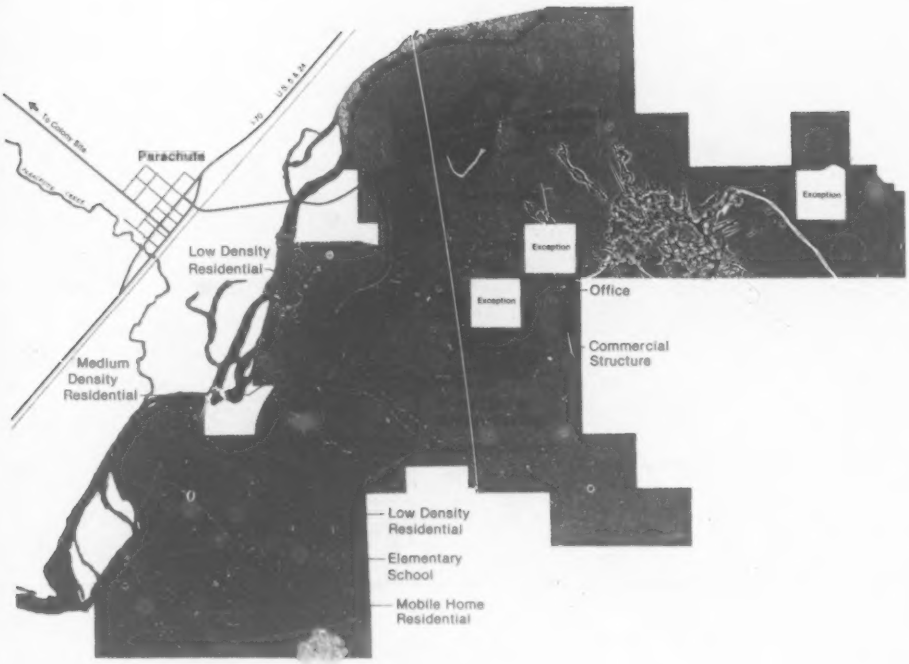


Overview: South End Terminal/Staging Area and Battlement Mesa



The Oil Shale Corporation/Colony Shale Oil Project

Battlement Mesa

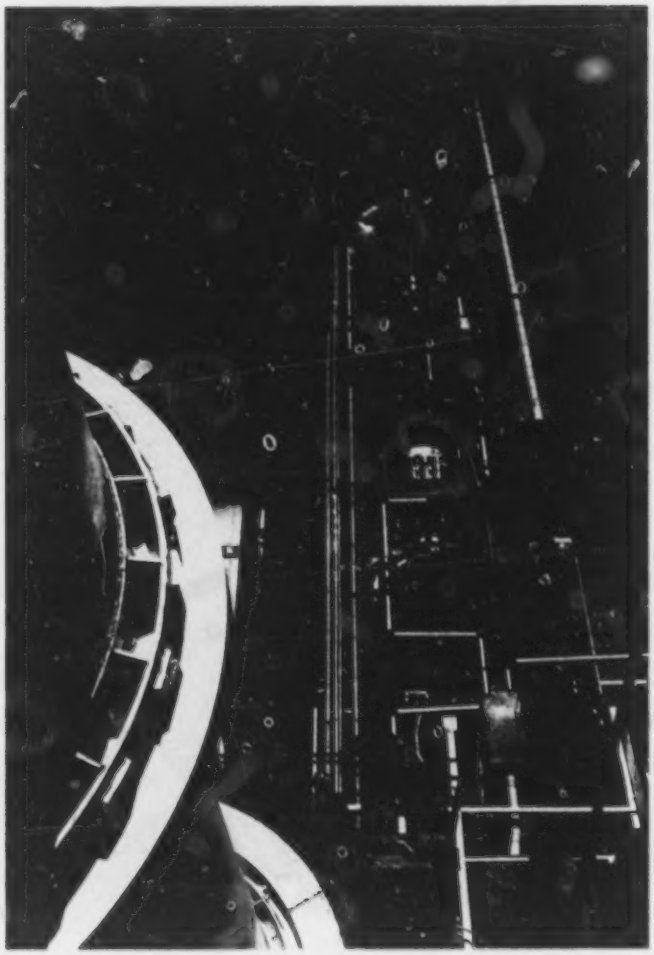


Overview: North End Mining, Processing, and Disposal Facilities

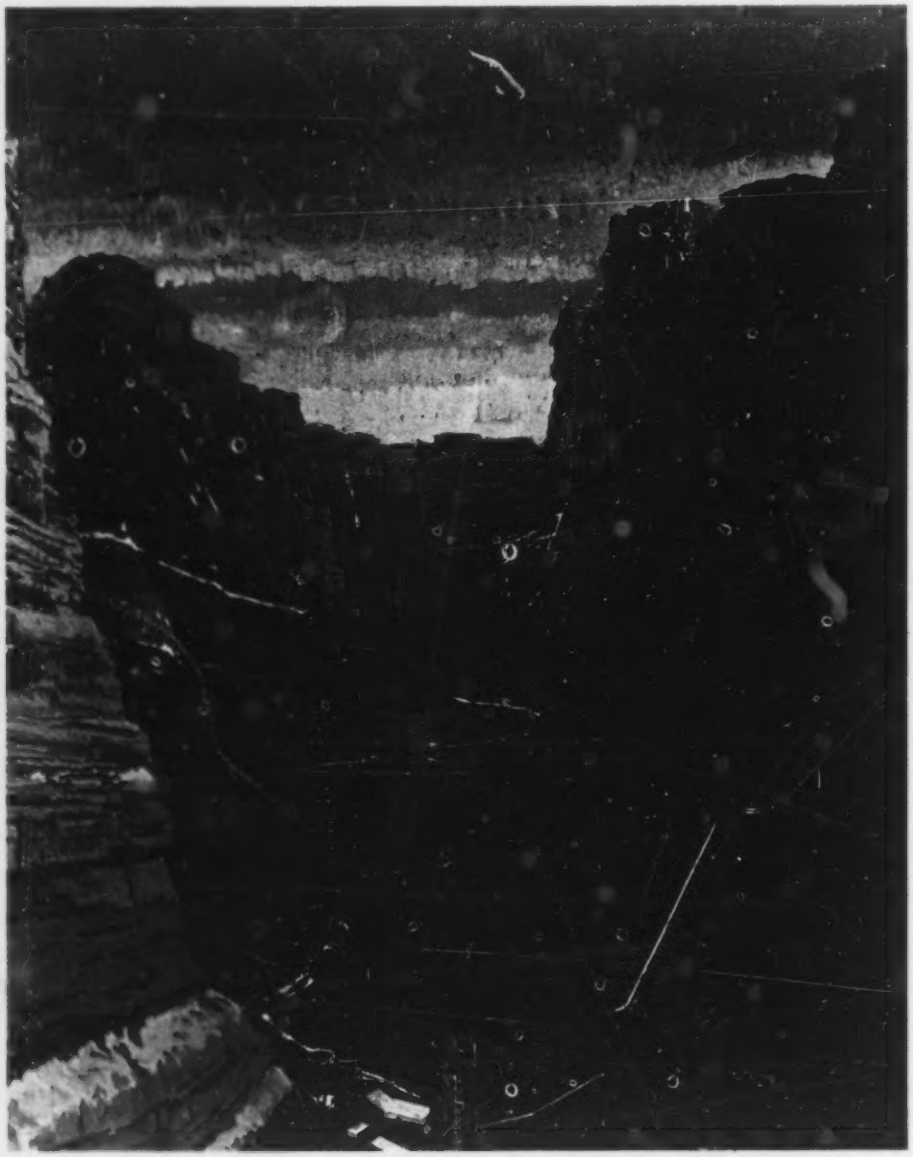
Colony Shale Oil Project's Semi-works Plant and Pilot Mine

A — Mine Mouth
B — Crusher
C — Crushed Shale Storage
D — Retort

Tosco II Semi-works Retort



Commercial Mine Bench and Semi-works

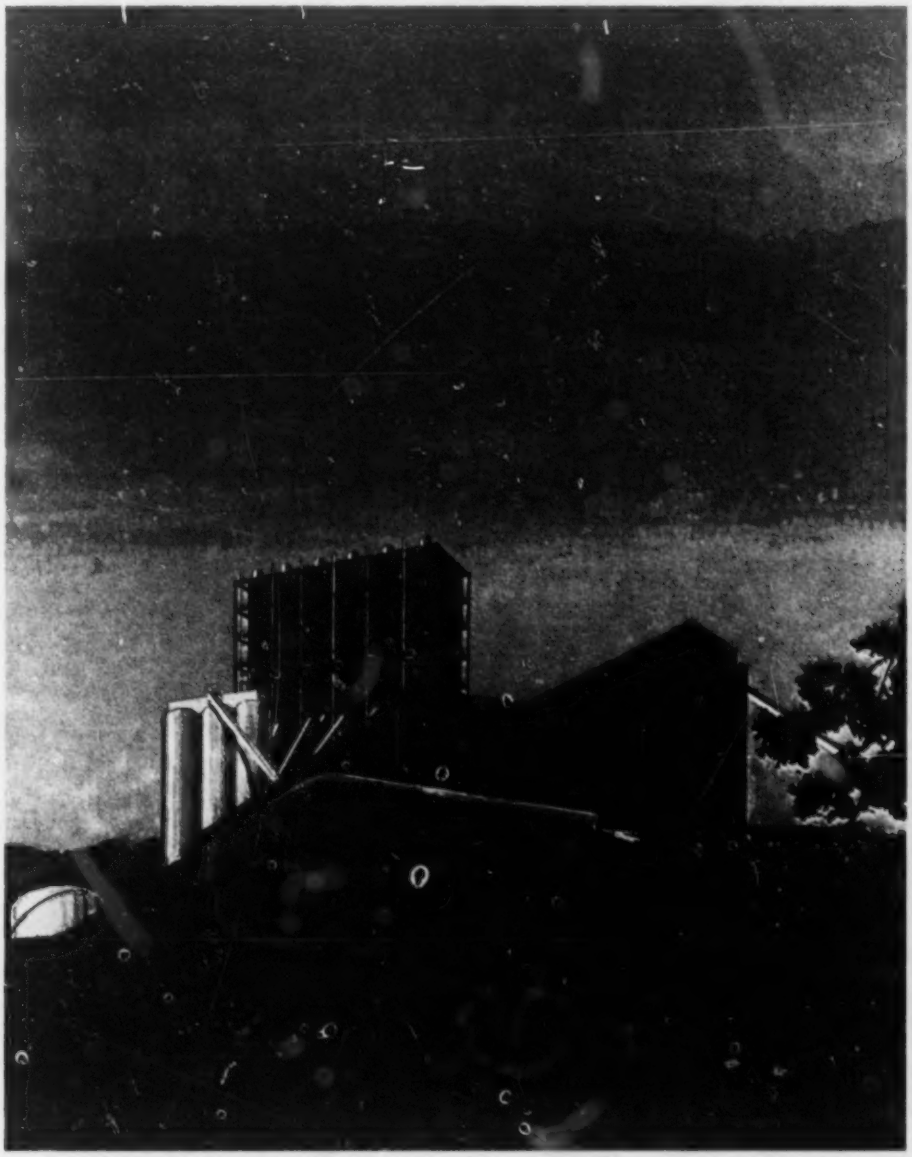


Room and Pillar Mining

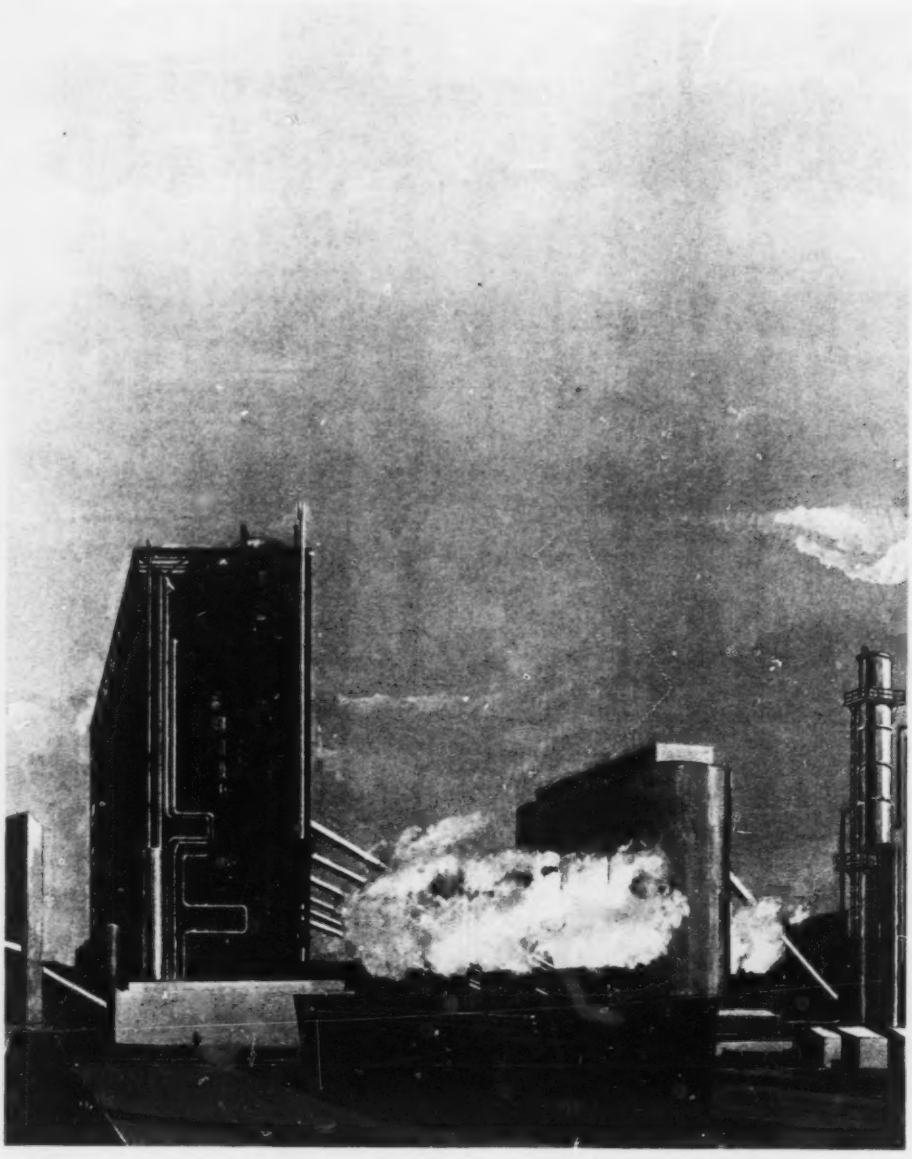
The Oil Shale Corporation/Colony Shale Oil Project

Mine Bench with Primary Crusher

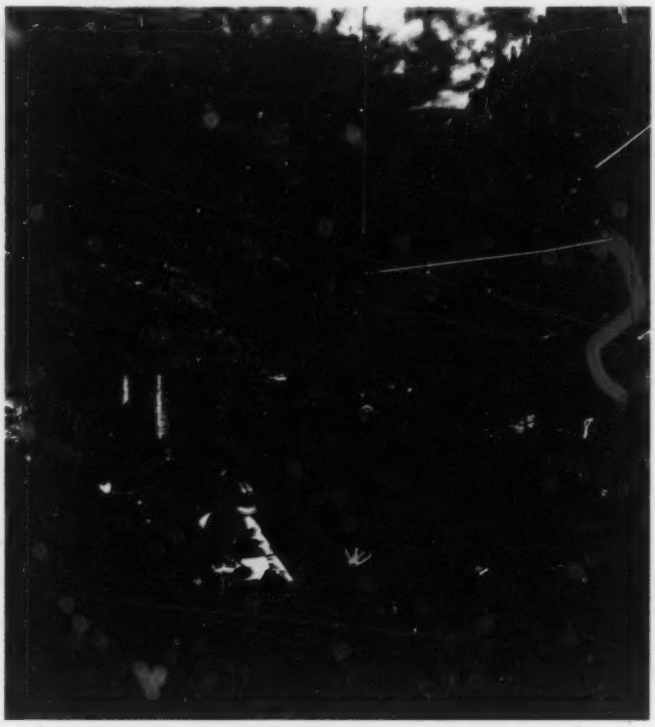
Secondary Crushing and Retorting



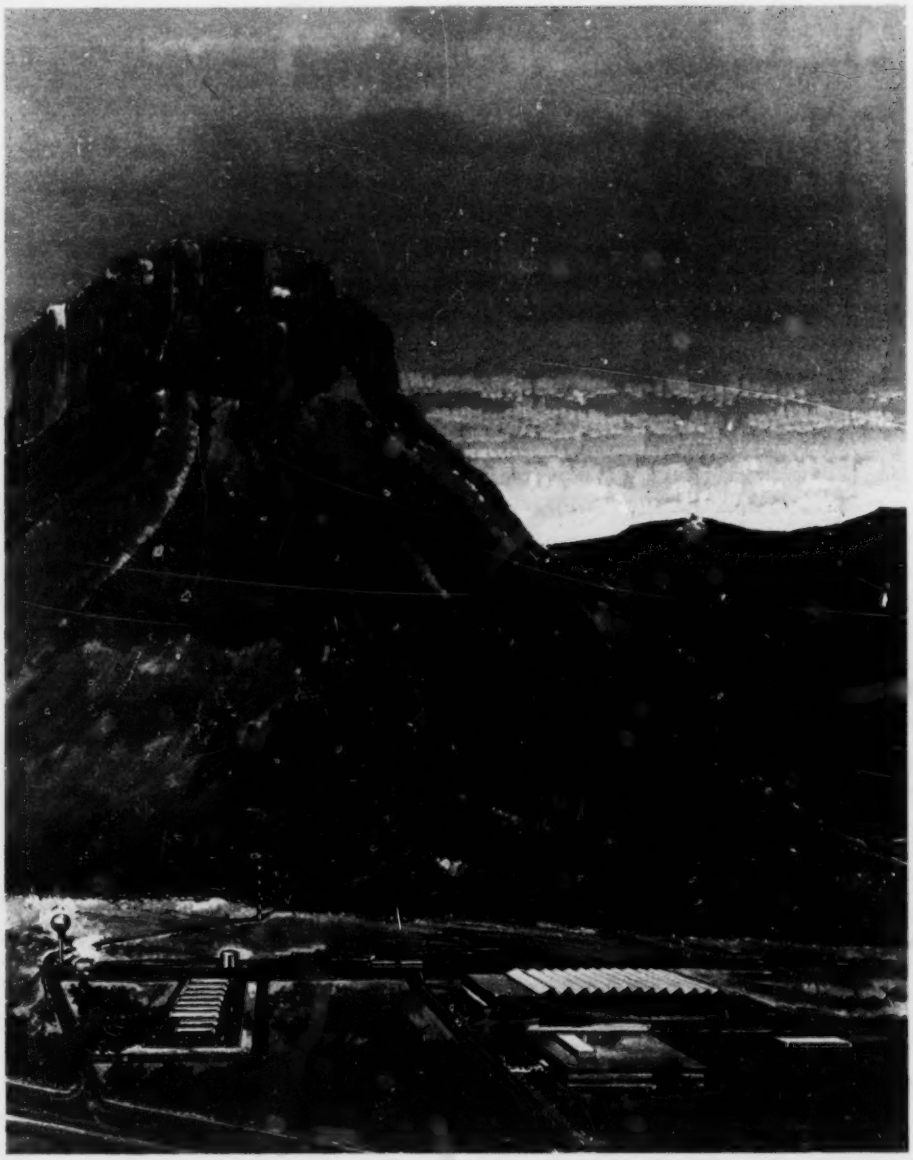
Retorting and Hydrotreating



Revegetating Processed Shale



Terminal/Staging Area



SECTION E
PUBLIC SUMMARY

1. PROPOSER AND PROJECT INFORMATION

The Oil Shale Corporation ("Oil Shale"), a wholly owned subsidiary of Tosco Corporation ("Tosco"),[1] has submitted a proposal for a loan guarantee covering 75 percent of Oil Shale's share of the costs in the Colony Shale Oil Project ("the Colony Project"). Tosco is an independent diversified energy company with more than 25 years' experience in the development of shale oil recovery technology and in the design of measures to mitigate the environ- mental and socioeconomic impacts of shale oil production. Tosco organized the Colony Project in 1964, and is proprietor of the TOSCO II retorting technology which will be used in Colony.

Tosco will participate in the project through its subsidiary, Oil Shale, making available its experience and expertise. Exxon Corporation ("Exxon"), which owns a 60-percent interest in the project, is not seeking financial assistance for its share of project costs.

Oil Shale and Exxon will direct the project as its owners, making all policy-level decisions. Key matters must be decided unanimously. Pursuant to an Operating Agreement between Oil Shale and Exxon, Exxon will serve as day-to-day Operator of the project through its Exxon Company, U.S.A. Operating Division.

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1 "Tosco" means Tosco Corporation, Oil Shale or both, as the context may require.

Tosco will provide some operating employees and will have a special role in areas related to its TOSCO II technology, environmental and socioeconomic matters and community development.

2. LOCATION, SIZE, AND READINESS OF PROJECT

The Colony owners plan to build and operate a 48,300 barrel per stream day (BPSD) commercial shale oil complex on their own fee oil shale lands in Garfield County, Colorado. The complex, which will be located approximately 15 miles north of the town of Parachute, will employ underground room and pillar mining, surface crushing and retorting, and onsite hydrotreating of raw shale oil. The principal product of the project will be hydrotreated shale oil, a premium refinery feedstock for direct processing into jet fuel, high octane unleaded gasoline, diesel fuel and other light products. It can also be used without further processing as a fuel for stationary turbines for power generation or other similar uses.

All major critical tasks preceding field construction of the Colony Project have been completed and construction has commenced. Construction of the site access road and mine bench commenced in June 1980, and is scheduled for completion early in 1981. Detailed design and cost estimates for the commercial-scale Colony plant were prepared by C F Braun & Co in 1974 at a cost of more than $12 million and were last updated by C F Braun & Co in 1979. The project is the only commercial oil shale project which has received a final Environmental Impact Statement from the U.S. Department of the Interior and all critical Federal and state permits necessary to commence construction.

3. RESOURCES TO BE USED

The Colony Project will involve the mining and processing of a 60-foot thick section of Mahogany zone oil shale which has an average richness of 34.7 gallons per ton. This deposit underlies some 4,763 acres of the 5,480 acre Colony property. The deposit is covered by 500 to 1,100 feet of overburden over most of the property except where it outcrops in the canyon walls. Access to the mine will be through adits in the outcrop level at an elevation of about 7,100 feet. The mining method will be conventional underground room and pillar. This method is widely used in large-scale mining of limestone, salt and other minerals. Mining equipment of the size and type to be used commercially has been extensively tested in prototype mining operations on the Colony property during which 1.2 million tons of oil shale were mined from the same 60-foot interval of the Mahogany zone oil shale. Eventually, the underground workings (room and pillar) will occupy approximately 4,500 acres.

Approximately 1,200 to 1,600 acre-feet per year of water will be required for construction. Approximately 660 gallons per minute (gpm) will be used during mining operations, and water needs for operation of the plant complex total approximately 5600 gpm. The Colony Project will use less than one percent of the average water flow in the Colorado River at Parachute, Colorado. A study completed in October, 1979 by the Colorado Department of Natural Resources for the Water Resources Council concludes that there is sufficient water available in the Upper Colorado River Basin to support a synfuels industry of approximately 1.5 million BPD without significantly affecting other consumptive uses.

All of the energy requirements for the complex, (except purchased electricity), will be supplied by the gas and liquid fuels produced by the project.

4. PROCESS TO BE USED

In the TOSCO II surface retorting process to be used in the Colony Project, approximately 66,000 tons per stream day (TPSD) of oil shale crushed to minus 1/2-inch are preheated and then further heated to approximately 900°F in a retort by direct contact with heated ceramic balls. At 900°F, the solid organic material (kerogen) in the oil shale decomposes into hydrocarbon vapors. This process is called retorting or pyrolysis. Cooling of the vapors produces crude shale oil and light hydrocarbon gases. Left in the retort is "spent shale," the residue of silt and dirt which went into the original formation of the oil shale in an ancient lake. At the discharge end of the retort, the ceramic balls and spent shale are separated by passing the mixture over a cylindrical trommel screen. Hydrocarbon vapor from the retort flows through a separator to remove entrained solids and then into a quench tower to condense the heaviest hydrocarbons present. Uncondensed hydrocarbons flow to a fractionator for further cooling and condensation to naphtha and gas oil. Uncondensed lighter hydrocarbons are further processed in conventional gas processing facilities to recover the lighter hydrocarbons and remove hydrogen sulfide.

The raw shale oil will be converted on site into a premium synthetic crude oil and other products by means of hydrotreating and coking processes which involve straightforward adaption of conventional refinery technology.

5. PRODUCTS TO BE PRODUCED

The hydrotreated shale oil product is superior to any conventional crude oil as a refinery feedstock for the following reasons: (1) it contains no residual oil fraction (high boiling material which must be sold as a low value product or converted to

lighter materials by costly processing steps); (2) it has an unusualy high naphtha content which is readily converted to high octane unleaded gasoline; (3) the light gas oil fraction meets specifications for No. 2 fuel oil or diesel fuel without further processing, (4) the heavy gas oil fraction is an excellent feedstock for a catalytic cracking unit or can be used as a blending stock for production of low sulfur fuel oil.

The hydrotreated shale oil will be pipelined south to a common carrier pipeline connection in Utah and thence to the Gulf Coast and South Central region. An alternative under consideration is pipelining north to Wyoming for common carrier pipeline shipment to Rocky Mountain and upper Midwest refineries.

Other products include liquified petroleum gas (LPG), sulfur, ammonia and coke. Below is a comparison of hydrotreated shale oil and Wyoming Sweet crude oil, the most nearly comparable conventional crude in the region.

Oil Properties	Colony Hydrotreated Shale Oil	Wyoming Sweet Crude Oil
Gravity, °API	41	39
Sulfur, Wt. %	0.01	0.18
Nitrogen, Wt. %	0.05	0.1
Pour Point, °F	55	5
Yields, Vol. %		
Naphtha (IBP-390°F)	40.7	37.0
Distillate (390°-650°F)	36.2	24.9
Hvy Gas Oil(650°-950°F)	23.1	21.1
Residual (950°F+)	0	17.0

Oil shale will sell hydrotreated shale oil to Tosco under a firm contract at fair market value, and Tosco will incorporate that premium synthetic crude oil as feedstock to its refining system. After refining, Tosco will sell specification Department of Defense (DOD) fuels, including JP-4 and diesel fuel; back to Oil Shale at market prices, competitive with comparable conventional petroleum product prices. Oil Shale then will resell these defense fuels to DOD at the same fair market value. Commercial products not sold to DOD will be comparable to those manufactured from premium quality conventional crude oil, and will be sold in existing Tosco markets. Because shale oil and its products are interchangeable in refineries, transportation systems and market uses with premium conventional crude oil, they will directly displace imported crude oil.

6. PROJECT WORK FORCE REQUIREMENTS

Manpower requirements for the construction and operation of the Colony Project will be substantial. Table I E-1 portrays the work force that will be required for construction of all project facilities, including Colony's new residential community at Battlement Mesa, discussed below in Section E-7.

As shown in Table I E-1, total employment associated with the Colony Project will peak at 3,325 persons in June of 1984. The permanent operational work force for mine and plant facilities will number 1,205 persons throughout the project life.

Construction and mining employment has grown considerably in Colorado during the past three years. However, demand for construction workers has recently decreased as residential construction has slowed in the State. The Colony Project is committed to draw as many workers as possible from regional and statewide labor pools. Unemployment in Garfield and Mesa Counties typically has

been higher than the state-wide average, and Garfield County recently has been designated as a labor surplus area by the U.S. Department of Labor. The Colorado Division of Employment and Training registered approximately 2,000 workers in Garfield County in 1979 who were skilled in various construction categories and were looking for work. Statewide, the total during the same period was over 25,000. Table I E-2 provides a breakdown of these applicants by skill category.

7. SUMMARY OF ENVIRONMENTAL AND SOCIOECONOMIC IMPACTS

Because the Colony Project has had a detailed, comprehensive, and stable design since 1974, it has been possible after more than eight years of sustained effort to obtain all of the major permits and approvals necessary for construction. As a result, Colony is now the only domestic commercial-scale oil shale project which can be launched in the next several years. The project's advanced state of readiness is confirmed by an October 1980 report by The Pace Company, Consultants and Engineers, Inc., which concludes:

> Colony is the only commercial oil shale project that is close to having all major permits. Union Oil Company of California has all of the approvals necessary to operate a 9,000 BPD demonstration module for an estimated 20 years. Tract C-a is permitted for its "modular development phase," during which time it will operate modified in situ test retorts leading to a decision point in 1983. Tract C-b, likewise, has permits for its precommercial "ancillary" phase which will last until 1987. The permits held by Multi Mineral Corporation, Geokinetics, Inc., and Occidental Oil Shale Inc. (Oxy) at Logan Wash are for research and development operations only. Chevron, Superior, Paraho, and Tracts U-a/U-b have not submitted applications for major permits.

TABLE I F-1
LABOR REQUIREMENTS COLONY PROJECT

Calendar Period	Construction	Operations	Total
4th Q, 1980	145	0	145
1st Q, 1981	350	0	350
2nd Q, 1981	620	0	620
3rd Q, 1981	710	0	710
4th Q, 1981	685	0	685
1st Q, 1982	680	0	680
2nd Q, 1982	945	0	945
3rd Q, 1982	1055	0	1055
4th Q, 1982	995	0	995
1st Q, 1983	1130	0	1130
2nd Q, 1983	1950	10	1960
3rd Q, 1983	2270	60	2330
4th Q, 1983	2415	100	2515
1st Q, 1984	2580	160	2740
2nd Q, 1984	3005	225	3230
3rd Q, 1984	2945	310	3255
4th Q, 1984	2595	415	3010
1st Q, 1985	2100	595	2695
2nd Q, 1985	1725	710	2435
3rd Q, 1985	975	845	1820
4th Q, 1985	165	930	1095
1st Q, 1986	165	1005	1170
2nd Q, 1986	260	1075	1335
3rd Q, 1986	260	1135	1395
4th Q, 1986	165	1165	1380
1st Q, 1987	165	1185	1350
2nd Q, 1987	260	1200	1460
3rd Q, 1987	260	1205	1465

TABLE I E-2
JOB SERVICE APPLICANTS BY OCCUPATION
October '78 to September '79
STATE OF COLORADO

Source: Colorado Division of Employment and Training

Excavating, Grading, Paving and Related Occupations	1927
Carpenters and Related Occupations	5057
Brick and Stone Masons and Tile Setters	335
Plumbers, Gas Fitters, Steam Fitter, & Related Occupations	724
Floor Laying and Finishing	267
Glaziers and Related Occupations	106
Roofers and Related Occupations	524
Miscellaneous Construction Occupations	15,680
Occupations in Extraction of Minerals	865
	25,485

WESTERN SLOPE PLANNING AREA II
Garfield, Mesa, Moffat and Rio Blanco Counties

Excavating, Grading, Paving and Related Occupations	288
Carpenters and Related Occupations	548
Plumbers, Gas Fitters, Steam Fitters, & Related Occupations	614
Roofers and Related Occupations	34
Miscellaneous Construction Occupations	572
Occupations in Extraction of Minerals	147
	2203

Since Tosco began the first spent shale revegetation tests in early 1965, the Colony Project has pursued a careful and thorough approach to environmental issues and is committed to development which will provide reliable domestic energy with a minimum of adverse effects on the natural and human environment. Major environmental tests, demonstrations, and studies dating back to Tosco's founding of Colony have been continuously managed as an integral part of testing and demonstrating the retorting and mining processes. To date, approximately $8.3 million has been spent by Colony on environmental, health and safety studies, socioeconomic planning, and community development.

In 1974, Colony submitted to the Bureau of Land Management (BLM) a 20-volume Environmental Impact Assessment (EIA) which was generally considered to be one of the most detailed, extensive, and thorough ever received by BLM. In June 1977, the BLM published a final Environmental Impact Statement (EIS) covering the entire project. During the three-year preparation of this document, the potential impacts of the Colony Project were subjected to detailed review and analysis by BLM, other interested Federal and state agencies, and the public.

Additional scrutiny has since been given to key aspects of the project by permit-granting authorities. In announcing issuance of the Prevention of Significant Deterioration of air quality (PSD) permit in July 1979, EPA Regional Administrator Alan Merson said, "Colony, in short, has passed our most stringent air quality tests, and has committed itself to using best available control technology and to comprehensive monitoring once operation begins."

In October 1980, the Colorado Mined Land Reclamation Board voted unanimously to issue a permit authorizing and controlling mining, construction, reclamation, and closure activities. In the

course of these proceedings, the Director of the Mined Land Reclamation Division advised the Board that the degree of knowledge and stage of development of the Colony reclamation plan was a quantum leap better than any plan previously submitted for an oil shale project.

Many other permits have been obtained at the Federal, State and County level in many review procedures, performed carefully and thoroughly over nearly a decade. These extensive reviews and the more than fifteen years of project planning, analysis and work performed by Colony provide assurance that there are no environmental or socioeconomic impacts so large or unacceptable as to present an obstacle to implementation of the Colony Project. There are necessarily some adverse impacts even after avoidance or mitigation. These lesser impacts are summarized below.

Air Quality Impacts

The construction and operation of the Colony plant will produce emissions of various air pollutants which will somewhat reduce air quality in the vicinity of the Colony property. However, Colony has obtained all air quality permits required to construct and operate the commercial facility described in this application. To acquire these permits, Colony demonstrated that the commercial facility will incorporate the best available control technology and will comply with all applicable Federal and state air quality standards and emission limitations and the EPA's PSD regulations.

Water Quality Impacts

The Colony Project is designed to operate as a zero discharge facility. All wastewater will be treated and internally recycled and reused. Runoff from irrigation and natural precipitation will

be captured and retained in catchment areas for use in plant operations. No water will be discharged to surface streams.

The potential for percolation of contaminated water from the spent shale disposal area into the groundwater system will be minimized by supercompaction of the bottom layers of the spent shale. Studies have shown that percolation could occur only through portions of the embankment less than five feet in thickness. Thus, salts and other dissolved solids that might enter the groundwater from this source should not appreciably affect groundwater quality.

Mining and subsidence could increase communication between aquifers in the mine area. The water quality of these aquifers is similar and the negative impacts should not be significant. Groundwater in the immediate vicinity of the project is not used for drinking water.

Spent Shale Reclamation

Spent shale produced in the commercial plant will be disposed of by the construction of stable embankments inside canyons of Davis Gulch which are located in the western portion of the Colony property. The spent shale disposal plan is based on safe and environmentally sound disposal procedures developed and demonstrated in a pioneer program started more than 15 years ago. In the disposal operation, cooled and moistened spent shale will be conveyed to the disposal area and then trucked to the active disposal site, where it will be spread in layers of optimum thickness for compaction into a durable embankment.

Following initial placement, contouring, compaction and controlled leaching of the spent shale, organic material and nitrogen-phosphorus fertilizer will be worked into the surface of the embankment and at least 18 inches of soil cover will be placed on the embankment. An irrigation system will be installed and plants seeded and the surface mulched. The plants to be used have been tested on site since 1971 for their ability to grow well on spent shale under local conditions. Watering and fertilization will continue as long as necessary, which field experience indicates will be two to five years. Native shrubs and trees will be planted at random or in clumps as needed to help blend the embankment into the surrounding area. Under Colorado law, the Colony owners are obligated to assure successful reclamation, and will provide a bond or other security of approximately $100 million.

The disposal plan also provides for a dam downstream of the disposal area to collect runoff. The collected water will be used for spent shale moisturizing or other uses in the zero-discharge facility.

Wildlife and Vegetation Impacts

Limited impacts to wildlife and vegetation within and in the vicinity of the Colony property will be unavoidable. However, much of the disruption will be temporary in nature, and it is anticipated that displaced species will reinvade former habitats after the conclusion of the construction phase, particularly along the pipeline right-of-way. Special care will be taken to protect and minimize damage to the habitat of rare and endangered species and to comply with the requirements of Federal and state laws applicable to such species. There are no Federally listed threatened or endangered species on the site.

Socioeconomic Impacts

The project will create many jobs, some of which will be filled by people not now living in the area. This new population and the secondary population which will accompany growth, could create "boom town" problems unless planned for. Using techniques pioneered by Tosco, Colony has developed a comprehensive socioeconomic mitigation plan, the centerpiece of which is a planned new community large enough to accommodate a population influx roughly twice that anticipated from the operation of the project. This new open community, Battlement Mesa, will be built on Colony lands, which Tosco commenced acquiring in the early 1960's. The building of this complete new community will do much to relieve unmanageable growth pressures. But even so, other communities within the Colorado River corridor will be impacted by growth resulting from the Colony Project. A community impact assistance program has been devised by Tosco and Colony to help other local communities prepare for growth associated with the project. This program will include timely submission of data pertaining to quantification of project-related population increases, technical assistance in defining likely primary and secondary impacts upon existing communites, assistance in obtaining state and federal impact assistance funds and, when necessary, carefully targeted grants. These plans constitute an unprecedented effort to ameliorate the socioeconomic consequences of the growth produced by a new industrial facility. Tosco believes that Colony, the Nation's first full commercial scale shale oil project, must show the way in socioeconomic planning and mitigation and in cooperation with State, County and local governments, if the industry is to become a reality.

Land Use Impacts

A significant amount of surface area will be altered from its natural state by the construction of the facility and the creation of a spent shale embankment. Reclamation of these altered areas will be an ongoing process throughout the life of the project. Landforms will be restored so that they blend with the surrounding topography and revegetation will be aggressively pursued.

There is a slight possibility that slow subsidence after completion of commercial mine development will cause change in the contour of surface areas within the Colony property, but this change will not significantly diminish the usefulness of the land for its sporadic uses for stock grazing and hunting.

Health and Safety Impacts

Most of the process steps in the Colony Project involve conventional commercial technology, equipment, and operations. The potential health impacts are well understood, and will be similar to those found in conventional construction, mining, and petroleum refining activities. These impacts will be eliminated or mitigated by procedures which have been proven effective in existing operations.

The most significant occupational hazards are dust and noise exposure from mining, crushing, and spent shale disposal operations. Incorporation of engineering controls and worker isolation in sound insulated, air conditioned, and air-filtered enclosures, when necessary, will reduce occupational exposures to less than those specified by OSHA and MSHA.

The occupational and environmental exposure to potentially carcinogenic compounds identified in oil shale materials is not a significant health risk. Extensive studies by Tosco and others have identified no cancer-related hazards unique to oil shale processing or products. Control technologies from existing petroleum refining and mining operations are applicable to and adequate for the Colony Project.

An extensive safety program will be incorporated into all phases of the operation, commencing with training programs at the time of hire and recurrently thereafter.

Conclusion

The Colony Project is the only full scale commercial oil shale project which has received all permits necessary to commence construction. Production of high quality hydrotreated shale oil could begin in 1985. The project incorporates unprecedented environmental, community development and socioeconomic impact planning and mitigation, including construction of a new community known as Battlement Mesa which will contain up to 7,100 dwelling units. The Colony Project will demonstrate the economic and environmental viability of commercial oil shale production and will serve as a model for a second generation of oil shale plants. Shale oil production can displace equal or greater amounts of foreign oil at competitive prices and with minimal adverse impact.

The project is economically sound at current costs and oil prices, and needs no subsidy. Tosco (through its subsidiary Oil Shale) needs a loan guarantee because it is far too small to assure that it can finance Oil Shale's share of project costs, and conventional secured project financing is not available for a pioneer project of this scale. The loan guarantee should not involve any cash expense to the Government, and successful completion and demonstration of the Colony Project should enable future projects to be financed without Government assistance.

Mr. FUQUA. Thank you very much.

You stated in your statement that Tosco and others have demonstrated some rather harmless hydrotreated shale oil. Who are the others involved in this—other than your company?

Mr. CHITTUM. There have been contract research laboratories particularly noted in the field of cancer research. The Eppely Institute was one, as I recall. Sloan-Kettering Laboratories, University of Cincinnati, I believe, was another. There might be a longer list; those are the only two I recall.

Mr. FUQUA. Have these been subjected to independent scrutiny in the scientific community, or are you aware of that?

Mr. CHITTUM. Yes. This information is not proprietary. It has been published and papers presented in many forums.

On Tosco's staff, we have a person who has a well-deserved reputation for being one of the real experts on the health effects of oil shale materials. Dr. Cooms gives papers on this subject and participates in forums on the average of four to six times a year, I would think.

Mr. FUQUA. Have you been dependent on any of the DOE national energy labs for any information or data or assistance in this?

Mr. CHITTUM. Our work on the health effects of oil shale really predates by several years much Government work.

Mr. FUQUA. Are they duplicating what you are doing?

Mr. CHITTUM. To a large extent. We do keep up with what is going on and find it to be generally confirmatory. I would not say that we are relying on it, although to the extent that it provides a larger body of information, perhaps that is helpful.

Mr. FUQUA. Dr. Scott, what type of work is your company doing in toxicological work?

Dr. SCOTT. At the present time, we are in the midst of an extensive toxicological study using reputable outside contractors. Previous to that, we ran an exhaustive literature search to be sure that we understood what had been done and who was currently working.

I can recite the extent of our work if you like. It is a page of notes here, but I do not want to take up your time unnecessarily.

In essence, it falls under side-by-side comparison work of shale products and matching petroleum products under skin painting studies, chronic dermal—looking for cancer—inhalation studies, mutagenicity studies, and reproductive studies. Our objective is to be sure that we understand any differences that may exist between shale products and the matching petroleum products.

Mr. FUQUA. Has EPA contacted either of your companies with respect to the preparation of the pollution control guidance documents?

Dr. SCOTT. Yes, sir. Our company is working on that through API primarily, just as a means of easy mechanism. Of course, we have had extensive discussions with DOE on such matters during the time we were negotiating our contract.

Mr. FUQUA. Mr. Chittum?

Mr. CHITTUM. We have as well been involved in the pollution control guidance document process for about 2 years, I guess.

Mr. FUQUA. Has it been useful?

Dr. SCOTT. I think it has been useful in the sense of finding out if there are any spots that we may have overlooked. I am not aware of any.

We are very sensitive to these issues—primarily as a result of our similar environmental control efforts on petroleum production and refining and marketing. There have been no surprises at all.

Particularly those of us who operate in California are highly sensitized to this issue because of the extraordinary emission control requirements that exist there, in comparison with the rest of the country.

Mr. CHITTUM. Mr. Chairman, I think that the value of that EPA effort may lie mainly in the creation of a compilation of data and facts for the growing number of people in Government and the public who have a concern about that.

It has a potential to create a common data base of facts.

I am not optimistic about the utility of trying to go beyond that and specify particular control measures.

Mr. FUQUA. Has the environmental R. & D. which has been pursued by the Federal Government been helpful to the shale industry?

Dr. SCOTT. I am not aware of any help, Mr. Chairman.

Mr. FUQUA. We probably could have done without it then?

Dr. SCOTT. Yes.

I do not mean to be critical, but I have to go back to what I said a moment ago that we are under such extraordinary requirements in California that basically the efforts elsewhere are second fiddle to what we do on a normal day-to-day basis.

Mr. FUQUA. Is that the same for you, Mr. Chittum?

Mr. CHITTUM. We rely primarily on our own work. We started it long before Government-sponsored research in these areas came about. That is why we are not particularly active now.

I can only speak really here for Tosco and the Colony project, since we have done the work. Whether somebody else would find it useful, I have not tried to think about from their perspective.

Dr. SCOTT. Some of these catalytic processes that I mentioned for cleaning up the intermediate and product streams are licensed extensively to other manufacturers and other refiners.

The sulphur control device that will be used in our facility was developed as part of our company's efforts.

Mr. FUQUA. How about the modified in situ process? Has any of their research been helpful to your company?

Dr. SCOTT. No, sir, not that I am aware of.

Mr. CHITTUM. We are not involved in that process except as an observer, so that I cannot speak to that, Mr. Chairman.

Mr. FUQUA. Mr. Scheuer?

Mr. SCHEUER. Thank you, Mr. Chairman.

Dr. Scott, you mentioned that you did not really feel there was a Government role for R. & D. in the synfuels area. What R. & D. do you think we do need to have accomplished, for what purposes, and who ought to do it?

Dr. SCOTT. I tried to touch on that in my statement, pointing out the only two areas that we could see right now as a role for research.

I want to be careful not to necessarily advocate Government research. I think Government has to play a critical role in it, but I am not prepared to say that Government alone should do this research.

The two areas that we identify are visibility provisions of the Clean Air Act—how to measure visibility specifically—and how we are going to cope with air quality modeling in rough terrain.

These issues are wide open. Nobody knows how to do these things. The need is clearly there if the provisions of the Clean Air Act remain as they are.

We think that research has to be done. We are doing everything we can to get involved, but there is a big gap which needs to be taken care of.

Mr. SCHEUER. In addition to visibility, how about the problems of clean air, clean water, solid waste disposal, and these areas in which you feel there is a legitimate Government role or do you think that industry ought to be doing it?

Dr. SCOTT. I think what has been done so far on air, water, and solid waste, as related to shale, is pretty well under control. The air controls are extraordinarily strict, as they properly should be. Water is kind of a nonissue, because we will not have any waste water discharges. All the data so far on solid waste indicate that the spent shale that will be produced is nonhazardous and will not go anyplace. The hazardous waste will be disposed of in properly permitted hazardous waste facilities.

Mr. SCHEUER. Do you feel the same applies to coal gasification and liquefaction?

Dr. SCOTT. I am really not close enough to it, Mr. Chairman, to give you a straight answer. I can talk a little bit about shale, but that is the extent.

Mr. SCHEUER. How much money are you devoting to environmental research on the synfuels problems as a percentage of total expenditures?

Dr. SCOTT. I would have to respond in writing, Mr. Chairman. I do not have that number in my head.

I can only say that I would guess it is several million dollars per year over the past 40 years, particularly on the cleaning up of shale products, which has been perhaps the most important shale research that has been conducted.

Mr. SCHEUER. I wonder if you could get us those figures.

Dr. SCOTT. I will certainly try to.

Mr. SCHEUER. And the percentage of your total expenditures for development of synfuels technology.

Dr. SCOTT. Let me make sure I understand the ground rules here.

This is the percent devoted to environmental R. & D. as a percentage of what base?

Mr. SCHEUER. The total investment in synfuels development.

One thing that concerns us is that we see a vacuum emerging. We seem to be seeing a very pronounced decline in the level of Government R. & D.—in both the Department of Energy and in EPA.

For example, in 1981 funding for R. & D. in EPA was $253 million. In the current fiscal year, which started at midnight last night, funding was originally planned for $190 million—down from

$253 million. Now with the President's new budget reductions, it will be down to about $167 million.

We get vibes from the executive branch that they will be projecting for the 1983 budget $122 million, which is less than one-half for 1983 of what they were actually spending—appropriated funds in 1981.

We see a sharp withdrawal of the Government from synfuels R. & D. as an ongoing process, and it concerns us. We do not see exactly what the incentives are for industry to fill that gap.

I feel strongly, and I think some of my colleagues share the feeling, that if we are in the midst of a major national priority to rid ourselves of our dependency on Persian Gulf oil, if we are going to look for alternatives to Persian Gulf oil, then we had better get our act together and know that we can live in an environmentally sound way and in a nondegrading health way with these technologies.

We support these technologies. I am a very strong supporter of these technologies, but I want to know that they are not going to have very serious and deleterious effects on either health or environment.

As I say, I see this vacuum developing. It is a matter of concern.

Dr. SCOTT. If I may, Mr. Chairman, I would like to give you our perspective on the incentive that private industry has for doing that kind of research and development.

The Federal laws—let alone the State laws—that cover this industry are extraordinarily strict, as you well know. Nearly all of those things somewhere have a citizen suit provision.

We feel it is absolutely essential that we carry out enough R. & D. to be sure that we have absolutely minimized any risks of violation of those laws before we even get started, because we are not about to expose several hundred million, or maybe a few billion, dollars and suddenly get that project stalled out because somebody claims we are in violation of some provision of the law. That, alone, is a terribly powerful incentive.

As I pointed out, we have done an extraordinary job, and we are extraordinarily proud of what we have done, in the cleanup R. & D. over the last 40 years.

Mr. SCHEUER. I appreciate the witness' candid answers.

Thank you very much, Mr. Chairman.

Mr. FUQUA. Mr. Carney?

Mr. CARNEY. Thank you very much, Mr. Chairman.

Mr. Chittum, in your statement on page 5 you said:

> In addition, the Colony project developers have voluntarily incurred an incremental cost of $100 million to $200 million in order to locate the plantsite on top of a mesa overlooking the mine rather than at a lower level, in order to protect local air quality.

Why does the change in the location of the facility enhance air quality?

Mr. CHITTUM. The perceived problem with the valley location which was the original site for planning purposes is that occasionally during the winter months in that part of Colorado—and this was information we got from our meteorological monitoring program—a fairly persistent inversion layer may form at a level below the mesa top.

Were that to form and persist during plant operations and not allow dispersion of normal types of pollutants that come from combustion processes, they could have been trapped and built up to an ambient level which would not meet air quality standards. The mesa top location is above those inversion layers.

We did not want to be confronted with the need to shut down the plant in order to preserve air quality.

Mr. CARNEY. If I am reading you correctly, you are using two forms of pollution control. One is the old adage that the solution to pollution is dilution. Two is that you are using the tools in business to take care of your pollution problem by putting it on the mesa and letting it go up into the atmosphere and go into someone else's backyard or vacationland.

The theory of gravity still holds. What goes up must come down, as long as it is not going to stay around your plant. It is going to be exported to come down in the form of acid rains or solids that will have a devastating effect on croplands, forestry, and soil conditions.

That, to me, is not a very responsible technique that you are using. I am absolutely horrified with what you are telling me.

That is incredible. I think that this committee should look into that very, very carefully, Mr. Chairman—at least this subcommittee—it is our responsible area.

I think the day we are allowing that solution to pollution is dilution is coming to a rapid end. We might not have a whole lot of money from EPA, but I can tell you that I think this Congress has the resolve to make sure it does not continue.

That I was shocked by. I thought that is what you were doing, and I just wanted to have it on the record.

That is all, Mr. Chairman.

Mr. CHITTUM. May I respond to that, Mr. Chairman?

Mr. FUQUA. Yes.

Mr. CHITTUM. The air emissions from the Colony plant are controlled to very stringent levels by the application of best-available control technology as determined by the regulatory agencies.

It is not possible to reduce the emissions to zero. How close to zero one tries to approach is a matter of economics which the Clean Air Act requires be factored into the selection of pollution control technology.

This is, in fact, a very clean plant. Some of the pollution control equipment has an efficiency of 99.995 percent reduction of particulates. The emissions are going to go ultimately to the same places from the mesa top that they would have gone to from the valley site.

What we have avoided is these meteorological trick conditions which for some periods of time would trap it into a very small space.

Mr. CARNEY. That is precisely what I am saying. You are using dilution as your answer to pollution.

When there is an inversion, you have a concentration of the problem. What is the problem? It is your emissions that are polluting the air. To solve the problem, you are exporting them.

I think that is reprehensible, quite frankly.

Mr. FUQUA. Mrs. Schneider?

Mrs. SCHNEIDER. I would also like to pick up on this whole question of pollution. Since this is a relatively new industry, how are you addressing the unregulated pollution?

Mr. CHITTUM. You are talking about unregulated air emissions?

Mrs. SCHNEIDER. Air or what may come about as a result of erosion.

Mr. CHITTUM. Let me address the air first.

We have extensively characterized—that is, examined chemically—the emissions that will come from the facility by taking samples at the pilot plant and at the semi-works operation.

We have examined the heavy metals and other elements that might be emitted and examined for various organic constituents which one expects to find in combustion processes. We have determined in what quantities they will be present. That determination reveals that those emissions will be at or below the levels of similar emissions from other industrial or utility facilities where combustion processes take place.

The erosion question is a matter of the design of the spent shale disposal embankment. It is set up in benches with water diversion and nonerosive facilities so that the runoff water does not have an opportunity to build up a rapid flow and cause erosion. What runoff is channeled around the pile is captured behind a dam at the foot of the pile and recycled into the process for irrigation or spent shale disposal or other processes.

Mrs. SCHNEIDER. Will this information that comes about as a result of your monitoring or investigating the pollutants be available to the public?

Mr. CHITTUM. Yes. There are a number of specific monitoring requirements in the permits which have been issued. To my knowledge, all of that data which we are required to transmit to permitting authorities is public information.

Mrs. SCHNEIDER. Are there not a great deal of provisions, however, for confidentiality within the contracts that you have signed?

Mr. CHITTUM. I cannot myself address what the contracts say. My responsibilities at Tosco are limited to the environmental affairs. I have been involved peripherally in the loan guarantee discussions.

I can say that we made a policy decision at least 10 years ago that although there might be some commercial value to environmental data, we would not attempt to keep that confidential for licensing purposes but that we would attempt instead, and have at all times to my knowledge, not attempted to assert a commercial privilege or confidentiality with respect to the environmental information which we have developed.

Mrs. SCHNEIDER. It is my understanding that the determination of confidentiality, according to the contract, would have to do primarily with the decisions being reached by the director of the Synthetic Fuels Corporation.

I, for one, am very enthusiastically supportive of the public being guaranteed access to the information, such as we have been discussing.

Mr. Chairman, I would very much appreciate the opportunity to leave the record open to submit additional questions or comments

on this question of contract confidentiality if I may. Then I do have one other small question which is on yet another topic.

Mr. FUQUA. Sure.

See appendix.

Mr. FUQUA. Dr. Scott, did you want to respond?

Dr. SCOTT. May I try to answer your question, Mrs. Schneider?

Mrs. SCHNEIDER. Sure.

Dr. SCOTT. If you have a copy of my statement and you will look at exhibit 4, you will see the monitoring requirements, all of which are public. There are some 6 or 7 pages of these, which are available to the public.

Additionally, all the monitoring data related to all environmental permits by law is public information, so there is no confidentiality at all on any kinds of emissions or effluents.

Mrs. SCHNEIDER. I am concerned about the information that comes out as a result of this new technology and new industry and the interim process.

Dr. SCOTT. That is right.

The point I am trying to make is that everything is wide open. Everything is out for public scrutiny. There are no secrets.

Mrs. SCHNEIDER. I have another question in reference to the amount of land.

About how many acres are used in the whole process for the commercial waste pile?

Mr. CHITTUM. I do not recall. It is on the order or magnitude of several hundred acres.

Mrs. SCHNEIDER. In the low hundreds—like 200—or more like 800?

Mr. CHITTUM. I prefer to send you an accurate answer if I may.

Mrs. SCHNEIDER. That I would very much like to have.

Mr. FUQUA. You can supply that for the record.

[See appendix.]

Mrs. SCHNEIDER. What is the largest size of your experimental piles right now that you are dealing with?

Mr. CHITTUM. I can supply that also in terms of tonnage. I know we have that information and also acreage.

Mrs. SCHNEIDER. Thank you very much, Mr. Chairman.

[See appendix.]

Mr. FUQUA. Mr. Scheuer?

Mr. SCHEUER. I recall seeing a Congressional Research Service report on the greenhouse effect and CO_2 in which they said that per unit of energy produced, synfuels-produced energy had more CO_2 than either coal or oil. Would you have any information on that?

Dr. SCOTT. Yes, sir.

Roughly 2 years ago, my staff prepared such an analysis for me to answer just such a question.

The answer is that there is no basic difference between shale operations and petroleum, when you take into account the total CO_2 emitted from the entire operation—from production all the way through final marketing.

In the case of certain coal products, I believe there is because of the higher amount of hydrogen which is required in order to bring the hydrogen-to-carbon ratio up to a marketable product.

In products like shale where your carbon-to-hydrogen ratio is quite similar to petroleum, there is really no difference.

The whole issue swings on what is the carbon-to-hydrogen ratio in the initial raw product. Of course, in coal, it is much more carbon than hydrogen.

Mr. SCHEUER. Would you be kind enough to supply us with that study which you referred to?

Dr. SCOTT. Yes.

Mr. SCHEUER. We would appreciate that very much.

Thank you, Mr. Chairman.

[See appendix.]

Mr. FUQUA. Thank you, Dr. Scott and Mr. Chittum. We thank you very much for being here with us this afternoon and sharing with us your information.

[See appendix.]

Mr. FUQUA. Our next panel will be Dr. Michael Massey of Environmental Research & Technology, Inc.; Dr. Michael Chartock of the University of Oklahoma; and Richard Brown of MITRE Corp.

Will you please come forward?

Dr. Massey, you may begin.

STATEMENT OF DR. MICHAEL J. MASSEY, TECHNICAL DIRECTOR, ENGINEERING GROUP, ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC., PITTSBURGH, PA.

Dr. MASSEY. Thank you, Mr. Chairman.

I am Michael Massey, technical director for the engineering division of Environmental Research and Technology, Inc., a leading firm in environmental consulting.

For the past 5 years, I and my colleagues at ERT have advised the DOE on the development and execution of that agency's health and environmental research program for the production of synthetic fuels from coal.

I am accompanied today by two of my colleagues: Dr. Richard Dowd, who recently joined ERT from the position of Acting Assistant Administrator for Research and Development at the EPA, and Dr. Matthew Reilly who has had extensive experience in the environmental aspects of synthetic fuels.

We have a detailed written statement for the record. However, to be brief I will limit my remarks here to a summary of that material.

Mr. FUQUA. We will make your statement a part of the record if you want to summarize.

Dr. MASSEY. For the sake of time, I will also focus here principally on health effects research.

I wish to state at the outset that we strongly endorse the Federal policy decision to proceed with the construction of a set of prototype synthetic fuel plants.

Health and environmental uncertainties do, of course, exist with synthetic fuel technology. Uncertainties are inevitable for any technology which has not undergone commercial testing.

These uncertainties are neither so minor as to be ignored nor so large as to preclude the start of the synthetic fuels industry. Many of these uncertainties concern the best ways of meeting existing

standards and the evolution of additional standards specific to synthetic fuels.

We believe strongly that:

One, such uncertainties can only be resolved by proceeding with the construction and operation of at least a prototype set of synthetic fuels plants.

Two, such a program can only proceed effectively in conjunction with both a strong program of environmental and health monitoring and an on-going program of long-term health and environmental research.

Through their Federal loan guarantee programs, both the Department of Defense and the new Synthetic Fuels Corporation must consider health and environmental compliance of synthetic fuels plants funded under their programs.

Each plant must develop and execute a comprehensive monitoring program which addresses unregulated toxic species in addition to a comprehensive list of currently regulated pollutants.

Neither the Department of Defense nor the Synthetic Fuels Corporation, however, has a charter to engage in research and development on health and environmental matters.

At the present moment, we see no agency of Government acting under a clear mandate to generate the long-term health effects data which will be needed to interpret the monitoring results from federally assisted synfuels projects.

This situation is a recent development and arises as the result of three decisions made by the new administration in the area of synthetic fuels.

One, termination of the DOE synthetic fuels demonstration program.

Two, redirection of the DOE's R. & D. mission away from synfuels commercialization toward long-term, high-risk research.

Three, severe reduction in funds available for research and development focused on the health and environmental aspects of synthetic fuel development.

Parenthetically, to date, these reductions have had their greatest impact on the EPA and the agencies receiving passthrough funds.

Prior to this time, DOE, for example, had developed major long-range health effects research programs in support of a number of specific synthetic fuel technologies, including shale oil, coal gasification, and coal liquefaction.

These programs have each had a particularly strong and effective coupling between health effects characterization and process engineering management which has greatly enhanced the value and constructive impacts of the health effects data.

Let me illustrate this point with a simple example. DOE's health research studies isolated and identified the principal chemical classes of compounds responsible for observed biological activity in raw coal liquids.

This information, in turn, provided the basis for identification of innovative engineering strategies for the management of the problem of toxicity in coal liquids. Key biologically active compound classes present in many coal liquids were ultimately shown:

One, to concentrate in the high boiling fractions comprising less than 20 percent of the raw coal liquid.

Two, to be highly susceptible to deactivation through mild hydrotreatment of either all or just the biologically active portion of the raw coal liquid.

These results have had a strong and positive influence on the development of coal liquefaction technology. They are the direct result of unusually strong and effective interactions between life science and engineering components in the DOE program.

Regardless of who has the mandate for the health effects research program, this kind of interaction should be encouraged in the future.

One of the key research needs which we have identified is the need to monitor the initial set of commercial-scale synfuels plants. The Congress, we know, has recognized this need and has often so instructed the agencies.

The Energy Security Act, for example, specifically requires the recipient of financial assistance from the Synfuels Corporation to prepare an environmental monitoring plan acceptable to the Board of Directors.

For various reasons, the Synfuels Corporation has not yet established criteria and guidance for the participants to prepare acceptable environmental monitoring plans.

It is important for the Synfuels Corporation, because it has final approval authority, to insure that the monitoring program will provide a complete and comprehensive data base for determining acceptability of the synfuels technology and for establishing any additional environmental, health, and safety standards.

A strong research program must accompany these monitoring and medical surveillance activities. Monitoring alone, although necessary, is not sufficient for a complete understanding of the health and environmental characteristics of synthetic fuels.

Accompanying research effort is needed to explore more deeply underlying scientific and technical relationships. Monitoring can tell us what is happening; research can explain why and suggest how to change it.

In summary, there is a continuing need for research into the environmental, health, and safety aspects of synthetic fuels technologies. We can expect that the private sector will take the lead in supporting research that yields better information about environmental controls for synthetic fuels and that demonstrates compliance with existing standards.

More than that is needed, however, and that is where the Federal Government has a role to play.

Continuing Federal support is essential to establish whatever health effects data bases are needed for this new industry and to confirm that there are no unanticipated, adverse effects.

That concludes my written remarks, Mr. Chairman, but I thought I would like to add one comment, after having sat through the first panel.

I would offer this as a brief supplement to what I have already said.

In my prepared remarks, I have avoided trying to suggest what an appropriate level of Federal involvement in the R. & D. program should be. I believe that is a very difficult number to estimate.

I appreciate your concern for the apparent budget gap that is developing. The numbers are very large. In preparing myself for this testimony, I looked at the same fiscal budgets that you cited here.

I also listened very carefully to Mr. Scott and Mr. Chittum, and I can appreciate their perspective as well. I believe that a fair amount of the testimony that I read could just as well have represented their position as that of as a third party—perhaps on the Government side.

It leads me to the conclusion that the only way to arrive at a reasonable estimate of the level of R. & D. that might be appropriate is to somehow bring informed industry and Government factions together—clearly more than they seem to be in the shale oil area today.

I would say that the position was expressed strongly by the previous panel that all was being done that needed to be done. I truly have no data to suggest otherwise, but I also do not think that there is a forum where that has been completely established.

That may be perhaps a way of resolving the question.

Mr. FUQUA. Thank you very much.

Dr. Chartock?

STATEMENT OF DR. MICHAEL A. CHARTOCK, SCIENCE AND PUBLIC POLICY PROGRAM, THE UNIVERSITY OF OKLAHOMA, NORMAN, OKLA.

Dr. CHARTOCK. Thank you, Mr. Chairman.

I appreciate the opportunity to testify on the adequacy of environmental research programs to support synthetic fuels development.

My comments are based on a range of studies on coal, oil shale, and other energy sources conducted at the science and public policy program of the University of Oklahoma during the past 7 years.

I would like to focus my comments this afternoon on three areas, primarily related to coal synfuels.

First, the adequacy of technical research on environmental controls and effects.

Second, the need for social and institutional research on the deployment of synthetic fuels facilities.

Finally, I want to express some views on who should be sponsoring and conducting this research.

Before proceeding, I want to indicate two underlying reasons for conducting environmental research programs in this area. First, to protect the public and occupational health and safety as effectively and efficiently as is possible. Second, to achieve an orderly progress in resolving conflicting perceptions about the relative hazards of synthetic fuels technologies.

By coordinating environmental research and process demonstration efforts, a synthetic fuels industry has the greatest opportunity to be successfully deployed, even at an accelerated pace in the future.

There are a number of scientific and technical unknowns concerning synthetic fuels processes that are of environmental significance. These uncertainties include:

Poor information on the type and amount of air emissions, liquid effluents, and solid wastes.

Lack of information on effects to both workers in the plant and those living around the plant.

No data on the performance of safety and emergency systems.

Limited or no information on the emissions characteristics of vehicles using the fuels produced.

I have summarized several concerns and research needs in each of these four areas in table 1 in the written testimony. I want to include several of these needs as examples in my following remarks:

This information is critical to resolving three policy problems:

One, the need for well-justified standards.

Two, the need for assured safety systems.

Three, the need to achieve a public consensus on synfuels acceptability.

Many questions about standards, safety, and acceptability cannot be resolved until demonstration or pioneer commercial plants are operated for several years. Thus, comprehensive environmental and safety information programs must be implemented now in order to effectively identify the environmental risks contemporaneously with the potential synfuels development during the next decade.

Some research and development programs should have been implemented several years ago but were not. For example, with the exception of a few tests on fuel combustion in stationary sources, such as powerplants, little effort has been made to test coal-derived liquids in transportation end use applications to determine hydrocarbon emissions.

As another example, the adequacy and reliability of wastewater treatment systems should be tested in conjunction with the current phase of commercial scale development in the advanced coal liquefaction processes.

Yet for reasons of economy, both the private industry and Government sponsors have chosen to eliminate testing of integrated wastewater environmental control systems from several plants.

Private incentives do not exist for this type of research and testing. Without Government sponsorship, the incentives for new or innovative control technology are lacking.

Most of the critical environmental standards for synfuels have not been promulgated. Perhaps the most important to the coal liquefaction industry are the proposed standards to control fugitive emissions of carcinogenic hydrocarbons that come from leaks around valves and fittings.

Information to establish these standards has not been based on coal liquefaction or even petroleum refinery experience but rather is based on studies at selected chemical plants.

Draft environmental standards establishing monitoring and maintenance activities to control fugitive airborne carcinogens were issued in 1979 but final standards have been indefinitely delayed.

The difficulties posed for coal liquefaction by the absence of standards are twofold:

One, there is little basis to evaluate environmentally plant designs or monitoring programs.

Two, it is not possible to assess the potential cancer risks or evaluate other health risks from synfuels facilities.

Some design standards which have been developed for petroleum refineries can be applied to coal liquefaction. However, coal synthetic fuels plants are different in several important ways from existing refinery experience.

One, large quantities of solids must be handled. Solids handling problems occur in scaling from small to commercial size facilities.

Two, the ash entrained in liquid streams erodes valves and fittings.

Three, comparatively large quantities of polynuclear aromatic hydrocarbons are present which pose a significant health risk.

Thus, new standards requiring research and development will be required. These include:

The fugitive airborne hydrocarbon monitoring standards.

Design and maintenance standards for pipes and fittings operating at high pressures and containing high velocity streams of hydrocarbons with entrained solids.

Vent/flare systems that handle entrained solids during emergency conditions.

An important part of a design of a coal synfuels plant are the safety systems that must remove toxic materials from the plant equipment during upset or emergency conditions.

These systems are crucial to relieve high pressures when plugging or upsets occur. They must rapidly burn materials released to the air.

These controlled combustor systems must completely eliminate carcinogens vented to the atmosphere. Yet research and development on controlled combustors is almost totally lacking.

Health and safety research programs, especially safety system studies, including fault free analysis and failure mode and effect analysis, for example, have not yet been applied despite the potential hazards in a coal liquefaction plant.

Equal in importance to these technical studies are softer research needs that affect the social impacts of a major synfuels program, and the policy or institutional mechanisms that influence, or can be used to influence, environmental choices.

I want to emphasize social and institutional research because public perceptions and institutional arrangements have been a major source of disorder, conflict, and delay in the extension or deployment of major technologies.

One only has to look at nuclear energy, offshore oil and gas, and coal surface mining to find existing and historical examples of conflicts that have limited both private sector and Government initiatives.

Examples of these softer research questions are:

What are the current public attitudes and concerns and how are they being addressed by the synfuels demonstration program?

To what extent has industry complied with existing regulations?

What is the range of potential changes in public attitudes toward regulation and how might these changes affect synfuels?

What institutional factors will influence the choices of technology, location, and rate of development?

The perceptions and attitudes of the public toward coal liquefaction have the potential for influencing site selection, environmental standards, and the pace of development.

Based on recent indicators, at least three important concerns are evident:

The public appears to be relatively uninformed about synthetic fuels.

No consensus exists about the potential severity of environmental and human health impacts. Perceptions range from very optimistic to very pessimistic.

The lack of credible information about the impacts from synthetic fuels makes the resolution of policy conflicts more difficult.

While the divergent opinions may not be completely resolvable, the situation could be improved with more reliable and credible impact information. This requires that research and monitoring programs not only be scientifically and technically comprehensive and sound but also that the research program must involve a diversity of interests in its planning and review; assessments must include site-specific components to directly inform those who may be affected; and the studies must be funded and carried out by parties who do not have a vested interest in the technology.

Many of the current environmental and health research programs do not meet these criteria. For example, biomedical research on the carcinogenicity of synthetic fuels mixtures is primarily sponsored by the Department of Energy and conducted through its national laboratories which are viewed by some groups as proponents of synthetic fuels development.

One way to deal with the conflict of interest perception would be to place federally sponsored environmental and health effects research in independent health agencies or those responsible for environmental controls and standards.

In summary, a strong and continuing research program on control technology and environmental and health effects is essential to support an emerging synthetic fuels industry.

The current program should be strengthened in several areas, including wastewater control technology development, emergency and safety systems development, and end use applications effects.

Research should also be conducted on public attitudes and siting and institutional choices which may be the largest existing impediments to an effective synthetic fuels program.

Finally, health and environmental research should be conducted by independent health research or environmental control agencies rather than agencies designated by Congress with primary interests in an aggressive synthetic fuels program.

Thank you for the opportunity to convey these remarks.

[The prepared statement of Dr. Chartock follows:]

TESTIMONY

by

DR. MICHAEL A. CHARTOCK

Science and Public Policy Program
The University of Oklahoma
Norman, Oklahoma

before the

Subcommittee on

Energy Development and Applications

and

Subcommittee on

Natural Resources, Agricultural Research, and Environment

U.S. House of Representatives

Joint Hearing on Synthetic Fuels
Environmental Research and Development

Washington, D.C.

October 1, 1981

TESTIMONY BY MICHAEL A. CHARTOCK

Mr. Chairman, members of the subcommittees, I appreciate the opportunity to testify on the adequacy of environmental research programs to support synthetic fuel development. My comments are based on a range of studies on coal, oil shale, and other energy sources conducted at the Science and Public Policy Program of the University of Oklahoma during the past seven years.[1] I would like to focus my comments this afternoon on three areas: First, the adequacy of technical research on environmental controls and effects; second, the need for social and institutional research on the deployment of synthetic fuel facilities; and finally, I want to express some views on who should be sponsoring and conducting this research.

Before proceeding, I want to indicate two underlying reasons for conducting environmental research programs in this area. First, to protect public and occupational health and safety as effectively and efficiently as is possible, and second, to achieve an orderly progress in resolving conflicting perceptions about the relative hazards of synthetic fuels technologies. By coordinating environmental research and demonstration efforts, a synthetic fuel

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[1]This testimony is based in part on work carried out for the Office of Technology Assessment by Michael A. Chartock, Michael D. Devine, Martin R. Cines, Martha W. Gilliland, and Steven C. Ballard.

industry has the greatest opportunity to be successfully deployed, even at an accelerated pace in the future.

There are a number of scientific and technical unknowns concerning synthetic fuels processes that are of environmental significance. The uncertainties include:

- Poor information on the type and amount of air emissions, liquid effluents, and solid wastes;
- Lack of information on effects to both workers in the plant and those living around the plant;
- No data on the performance of safety and emergency systems; and
- Limited or no information on the emissions characteristics of vehicles using the fuels produced.

I have summarized several concerns and research needs in each of these four areas in Table 1 in the written testimony, and I want to include several of these needs as examples in my following remarks. This information is critical to resolving three policy problems:

(1) The need for well-justified standards;

(2) The need for assured safety systems; and

(3) The need to achieve a public consensus on synfuels acceptability.

Many questions about standards, safety, and acceptability cannot be resolved until demonstration or pioneer commercial plants are operated for several years. Thus, comprehensive environmental and safety information programs must be implemented <u>now</u> in order to effectively identify the environmental risks contemporaneously with potential synfuels development during the next decade. Some research and development programs should have been implemented

TABLE 1: SELECTED TECHNICAL INFORMATION GAPS

Area	Examples	Concern	Problem	Implications
Process Emissions and effluents	Emissions of "reduced" sulfur compounds	Hydrogen sulfide, carbonyl sulfide, carbon disulfide	Neurotoxic agents in low concentrations; implicated in reproductive disorders	Emission and exposure levels expected to be low, but problems from fugitive or accidental emissions could be significant
Products	Light and medium weight liquids toxicity	Presence of benzene, other toxic aromatics, and trace chemicals	These chemicals are known to cause leukemia and induce liver tumors. Current research focuses only on skin cancer and bacterial mutagenesis	Composition of products known but environmental significance ambiguous. Indicates need for wider range of carcinogen testing methods
Safety systems	Controlled combustion systems	Little data available on actual design. Toxic mixture will be introduced into the system	Failure in performance of controlled combustor could result in intermittent releases of toxic compounds	Alternative design choices, performance criteria and testing and monitoring procedures need to be developed
End use	Gasoline and diesel fuel use	Particulate, nitrogen and sulfur emissions; effects on catalytic converters	Fractions of coal derived naphtha mixtures in product markets is uncertain; environmental impact uncertain and untested	Better environmental information on fuel characteristics and end-uses is needed

several years ago but were not. For example, with the exception of a few tests on fuel combustion in stationary sources such as power plants, little effort has been made to test coal derived liquids in transportation end use applications to determine hydrocarbon emissions.

As another example, the adequacy and reliability of wastewater treatment systems should be tested in conjunction with the current phase of commercial scale development in the advanced coal liquefaction processes. Yet, for reasons of economy, both private industry and government sponsors have chosen to eliminate testing of integrated wastewater environmental control systems from several plants. Private incentives do not exist for this type of research and testing, and without government sponsorship, the incentives for new or innovative control technology are lacking.

Most of the critical environmental standards for synfuels have not been promulgated. Perhaps the most important to the coal liquefaction industry are proposed standards to control fugitive emissions of carcinogenic hydrocarbons that come from leaks around valves and fittings. Information to establish these standards has not been based on coal liquefaction or even petroleum refinery experience, but rather is based on studies at selected chemical plants. Draft environmental standards establishing monitoring and maintenance activities to control fugitive airborne carcinogens were issued in 1979 but final standards have been indefinitely delayed.

The difficulties posed for coal liquefaction by the absence of standards are two-fold:

(1) There is little basis to evaluate environmentally plant designs or monitoring programs; and

(2) It is not possible to assess the potential cancer risk or evaluate other health risks from synfuel facilities;

Some design standards which have been developed for petroleum refineries can be applied to coal liquefaction. However, coal synthetic fuel plants are different in several important ways from existing refinery experience.

- Large quantities of solids must be handled. Solids handling problems occur in scaling from small to commercial size facilities;
- The ash entrained in liquid streams erodes valves and fittings; and
- Comparatively large quantities of polynuclear aromatic hydrocarbons are present which pose a significant health risk.

Thus, new standards requiring research and development will be required. These include:

- The fugitive airborne hydrocarbon monitoring standards;
- Design and maintenance standards for pipes and fittings operating at high pressure and containing high velocity streams of hydrocarbons with entrained solids; and
- Vent/flare systems that handle entrained solids during emergency conditions.

An important part of the design of a coal synfuels plant are the safety systems that must remove toxic materials from the plant equipment during upset or emergency conditions. These systems are crucial to relieve high pressures when plugging or upsets occur, and they must rapidly burn materials released to the air. These controlled combustor systems must completely eliminate carcinogens

vented to the atmosphere. Yet research and development on controlled combustors is almost totally lacking. Health and safety research programs, especially safety systems studies including fault tree analysis and failure mode and effect analysis, for example, have not yet been applied despite the potential hazards in a coal liquefaction plant.

Equal in importance to these technical studies are "softer" research needs that address the social impacts of a major synfuels program and the policy or institutional mechanisms that influence, or can be used to influence, environmental choices.

I want to emphasize social and institutional research because public perceptions and institutional arrangements have been a major source of disorder, conflict, and delay in the extension or deployment of major technologies. One only has to look at nuclear energy, offshore oil and gas, and coal surface mining to find existing and historical examples of conflicts that have limited both private sector and government initiatives. Examples of these "softer" research questions are:

(1) What are the current public attitudes and concerns and how are they being addressed by the synfuels demonstration program?

(2) To what extent has industry complied with and compliance with existing regulations?

(3) What is the range of potential changes in public attitudes toward regulation and how might these changes affect synfuels?

(4) What institutional factors will influence the choices of technology, location, and rate of development?

The perceptions and attitudes of the public toward coal liquefaction have the potential for influencing site selection, environmental standards, and the pace of development. Based on recent indicators, at least three important concerns are evident:

- The public appears to be relatively uninformed about synthetic fuels;
- No consensus exists about the potential severity of environmental and human health impacts; perceptions range from very optimistic to very pessimistic; and
- The lack of credible information about the impacts from synthetic fuels makes the resolution of policy conflicts more difficult.

While the divergent opinions may not be completely resolvable, the situation could be improved with more reliable and credible impact information. This requires that research and monitoring programs not only be scientifically and technically comprehensive and sound, but also that:

- The research program must involve a diversity of interests in its planning and its review;
- Assessments must include site-specific components to directly inform those who may be affected; and
- The studies must be funded and carried out by parties who do not have a vested interest in the technology.

Many of the current environmental and health research programs do not meet these criteria. For example, biomedical research on the carcinogenity of synthetic fuels mixtures is primarily sponsored by the Department of Energy, and conducted through its national laboratories, which are viewed by some groups as proponents of synthetic fuel development. One way to deal with the conflict of interest perception would be to place federally sponsored environmental and

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health effects research in independent health agencies or those responsible for environmental controls and standards.

In summary, a strong and continuing research program on control technology and environmental and health effects is essential to support an emerging synthetic fuels industry. The current program should be strengthened in several areas including wastewater control technology development, emergency and safety systems development, and end use applications effects. Research should also be conducted on public attitudes and siting and institutional choices which may be the largest existing impediments to an effective synthetic fuels program. Finally, health and environmental research should be conducted by independent health research or environmental control agencies rather than agencies designated by congress with primary interests in an aggressive synthetic fuels program.

Mr. FUQUA. Thank you very much.
Now we will hear from Dr. Brown.

STATEMENT OF DR. RICHARD D. BROWN, DEPARTMENT STAFF, THE MITRE CORP., McLEAN, VA.

Dr. BROWN. Thank you, Mr. Chairman.

I am pleased to appear before you today at this joint hearing of the Subcommittees in order to testify on the adequacy and prospects of Federal synfuels research and development programs and the activities which will make a timely and effective contribution to the understanding and solving of health and environmental problems facing the synfuels industry.

For the last 3 years, working at the MITRE Corporation, I have served as the Executive Secretariat, for the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies.

The committee was established on an ad hoc basis in response to President Carter's environmental message on May 23, 1977, in which he directed the administrators of ERDA and EPA and the Secretary of HEW to establish a joint program to identify the health and environmental effects of each advanced technology that is the subject of Federal research and development. That directive was contained within the coal section of his message.

Within the last 3 years, over 18,000 copies of reports of the committee have been distributed. Many eminent scientists participated in their development, including my colleagues testifying with me here today.

Michael Massey participated in a synthetic fuels assessment exercise. And Michael Chartock was a major reviewer of the committee's report on oil and gas technologies.

On August 30, 1981, the committee completed its activities, having sponsored and disseminated eight major reports. I have provided a list of these reports within my written statement, previously submitted to the subcommittees.

My remarks are not on behalf of the former Federal Interagency Committee or any particular agency, but are the result of my considerable experience with the committee in support of the program planning activities of several agencies and with respect to technical studies relating to the monitoring of synthetic fuels facilities.

I have four important recommendations for consideration before the subcommittees. I will be brief.

Regarding the monitoring of pollutants, we are well-aware of the potential for the release of numerous kinds of pollutants from synfuel facilities. Most of these are unregulated. We have heard such names as aliphatic hydrocarbons, benzene and related compounds, polynuclear aromatic hydrocarbons, heterocyclic sulfur, oxygen, and nitrogen compounds, phenols and alcohols, amines, cyanide derivatives, and the list goes on and on.

Most of these are currently unregulated. However, we can sample and we can measure these diverse emissions. We do have the capability, and we are possible with off-the-shelf technologies.

As the synthetic fuel industry develops, we probably shall see only a few commercial facilities receiving financial assistance from

the Synthetic Fuels Corporation. Most of the facilities, perhaps as many as 160, will be financed entirely within the private sector.

The monitoring requirements in the Energy Security Act will not extend to these privately financed facilities.

A comprehensive and responsive monitoring program is needed at each large synthetic fuel facility. The media which act as pathways of pollutant movement and which require monitoring, include the unsaturated zone below these facilities, surface aquifers and deep aquifers for leachates, surface waters for pollutants derived from leachates and controlled discharges, and the atmosphere for contaminants associated with airborne and controlled emissions.

My first recommendation is that comprehensive source and ambient monitoring of both regulated and unregulated pollutants be required to be an integral part of the operation of large commercial synfuel facilities.

This should include baseline monitoring.

The collected data should be in the public domain—that is, it would be available for public scrutiny.

A Federal agency—for example, the U.S. Environmental Protection Agency, which has established an extensive quality assurance program in handling of data—should be given the oversight responsibilities for the data collection process.

The premise that I have presented is that we may not, as yet, clearly have understood the enormity of the problem. This understanding can only come about after a considerable amount of data have been amassed from synthetic fuel facilities actually processing the different grades and compositions of coal and oil shale that exist throughout the country.

Other than recognizing conceptual problems, I do not feel that we know in every detail what will be emitted from these future facilities.

It would be improper to embark on the development of a new set of regulations until we fully understand if they are necessary and we can identify the pollutants which should be the target of such regulations. Effective monitoring is the key to solving this problem.

Regarding research priorities in relationship to the development of synthetic fuels, a number of high priority research needs must be met prior to the development of a domestic synthetic fuels industry. These focus on worker exposure to toxic substances and the development of adequate protective equipment and monitoring devices.

Prospective morbidity studies need to be initiated along with bioassay studies.

Cutting across all health research areas is the need for a viable and responsive risk assessment program.

In the areas of air quality and ecological effects, acquisition of preconstruction, baseline information is critical, together with the development of reliable techniques to monitor the unique pollutants associated with the synfuels industry.

These priority research needs are summarized in my written submission. They are detailed in a report sponsored by the committee which has been distributed to the subcommittees, which is entitled, "Health and Environmental Effects of Synthetic Fuel Technologies: Research Priorities."

Since the report was developed in fiscal year 1980, new analysis is needed to account for the interim changes in light of technology advances, changing synthetic fuels development strategies, and very recent adjustments—quite important adjustments—in research budgets within pertinent Federal agencies.

Regarding my second recommendation, in dealing with research priorities, is that an interagency task force should be instructed to review all synfuels health, environmental, and socio-economic effects research within Federal agencies for the purpose of identifying redundancies, adequacy, and priorities with respect to the timeliness of information needed to understand and solve health and environmental problems posed by the emerging industry.

The outcome of this review should be an integrated and timely national program of research with definite targets and outputs designed to meet emerging problems.

The program should specify a 5-year plan which Congress can review for the purpose of assigning multiyear funding commitments and also oversight reviews.

Regarding cumulative effects:

The societal problems posed by the emerging synfuels industry must be viewed within a broad context. There are many development activities which are occurring simultaneously with synfuels development. This cannot be ignored.

The often-cited example is the development of energy in the West, primarily within the States of Utah, Wyoming, and Colorado. But similar diverse development activities can affect the States within the Ohio River basin and in Appalachia.

Accelerated energy resources, defense, and natural resources development will place a severe strain on local, State, and regional entities in dealing with cumulative effects of multifaceted development. I am also including within that health and environmental effects, as well as socioeconomic effects.

Of all the information on societal impacts associated with development, little is adequately disseminated to all potential users. Federal and State agencies and industry frequently study the same localities and issues, often with a lack of information flow between them.

The localities themselves are not always provided with the results of these studies. In many cases, the local perspective is not taken into account, and cumulative impact is not addressed.

Federal outreach information programs have not been providing maximum benefit to impacted communities, and local officials often are not cognizant of appropriate mechanisms or contacts for acquiring technical information.

As examples of our ineffective capability to provide needed information to local communities, I cite the following:

I recently was called on the phone by a representative of the Ute Indians of Ignacio, Colo., who had been attempting for 2 months to acquire certain information on the effects of oil shale development on public health. The representative had been shunted from one office to another before being able to acquire the proper information from my supply of committee-sponsored materials.

Last year at a public hearing in Henderson, Ky., I received 50 requests for synfuels information, dealing with health and environ-

mental impacts, from local farmers who were not able to identify proper sources of such information within the Federal Government.

My third recommendation is that an interagency task force be charged with the responsibility of conducting a feasibility study and making recommendations for the development of a clearinghouse to broker such technical information among Federal and local entities.

The feasibility study should identify local, State, and regional entities concerned with societal impacts, define technical information needs for these entities, identify existing sources of information and define the relevant types of information which can be obtained from those sources, identify the gaps in the availability of technical information versus the needs at the local, State, and regional levels, and identify and evaluate the usefulness of existing clearinghouse or organizational and institutional entities to coordinate an outreach effort of providing relevant technical information.

My last and most important recommendation and topic deals with coordinated Federal research.

In these times of fiscal constraint, it is all the more important to identify and remove redundancies within and across all energy activities in terms of research—not only within one agency, but among agencies involved with similar research.

By removing redundancies, the "freed" funds can be reallocated to fill gaps in high priority areas.

Such coordinated research will need to have the impetus of a statute. This is needed for two reasons:

One, no one agency can perform this task alone. Any agency will need a strong mandate to interact with other agencies when each has a unique mission guiding its own funding allocations and budget submissions.

Two, with funding cutbacks, agencies have attached priorities only to activities mandated under statutes or regulations.

The instructions to the agencies must be explicit with respect to cooperative budget submissions and research plans. For energy-related research, the interagency task force should at least be comprised of EPA and the Departments of Energy, HHS, Interior, and Agriculture.

In order to avoid dominance by any one entity, the Executive Office of the President, either through CEQ or OSTP, should be identified as a nonvoting chairman. This would link the coordinated research efforts directly to the needs of implementing national policies and would assure parity among the agencies of the task force.

This task force also could be mandated the responsibility of overseeing the clearinghouse functions identified in recommendation three and in assuring a timely and effective research response to address the health and environmental concerns relating to the emerging synfuels industry, as identified in recommendation two.

I hope these comments have been useful. Detailed information is contained within my written statement.

As a final note, in my experience with all the concerns and research which has been going on to date with relationship to syn-

thetic fuels, I believe we can have a viable domestic synfuels industry that is not a threat to public health or the environment.

This will take work, but I know it can be done. It will require sound process control, dedication to good housekeeping practices within the facilities themselves, effective control technology, and monitoring; but it can be accomplished.

Thank you for the opportunity to appear before you today. If you are interested, I am prepared to address the implications of recent budget cuts on the timeliness and effectiveness of specific synfuels research programs.

I will be happy to respond to any questions you may have.

[The prepared statement of Dr. Brown follows:]

WRITTEN PREHEARING

Statement of
Richard D. Brown
Department Staff
The MITRE Corporation

Submitted to the Subcommittee on Energy Development and Applications
and the
Subcommittee on Natural Resources,
Agriculture Research
and Environment
of the Committee on Science
and Technology
United States House of Representatives

28 September 1981

BIOGRAPHICAL SKETCH

Dr. Richard D. Brown, department staff at The MITRE Corporation, is a limonologist and specializes in the development and management of research programs relating to the health and environmental effects of emerging energy technologies. For the past three years, Dr. Brown has served as Executive Secretary for the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies.

Prior to his association with The MITRE Corporation, he established the Department of Water Sciences at Jack McCormick and Associates, Inc., an environmental consulting firm. He also established graduate level courses in advanced limnology and water pollution as a member of the graduate faculty at Indiana State University.

In response to demands imposed by the rapidly advancing technology and high costs associated with modern defense systems, The MITRE Corporation was formed at the request of the United States Government as a Federal Contract Research Center in 1958. In 1967, MITRE extended its work program to include civilian agencies. Working in the public interest, MITRE is dedicated to solving complex technological problems. The professional multi-disciplinary staff uses the techniques of systems engineering and economic analysis to help plan, develop, implement, and evaluate large, complex programs.

MITRE's not-for-profit status frees it from marketplace pressures, allowing its staff to concentrate on objective, conflict-free research and analysis. MITRE does not compete with profit-seeking firms and has no vested interest in serving an entity other than its principal client--the Federal government.

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INTRODUCTION

The joint Subcommittee hearing on 1 October 1981, will focus on the adequacy of current Federal research and development programs to deal with threats to human health and the quality of the environment posed by the emerging synthetic fuels industry. There are several different topics I would like to address and points to make with respect to this subject. Specific information contained within this testimony has been drawn from several sources, including reports sponsored by the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies, technical reports prepared by the U.S. Environmental Protection Agency, and published papers in scientific journals.

I shall present testimony in level of specificity, beginning with the most detailed comments, relating to parameters of concern, to the most broad, all encompassing, and perhaps most important topic,--interagency coordination. The topics in order are: (1) the complexity of pollutants, (2) research priorities, (3) cumulative effects, and finally (4) interagency coordination. I shall conclude my statement with a summary and several recommendations.

DISCUSSION

Complexity of Pollutants

Introduction

As noted in the background information prepared for the hearing, control of sulfur dioxide is a recognized pollution abatement procedure with respect to synfuel facilities, but such chemicals as polycyclic aromatic hydrocarbons (some of which may be mutagens or carcinogens) are not regulated. A point I wish to make is that there may be too much emphasis on the polycyclic aromatic hydrocarbon group of pollutants, especially benzo(a)pyrene, without recognition of the nature and extent of other types of hazardous substances which can be released from such facilities. These other types of pollutants also are largely unregulated. The following is a brief exemplary coverage of the complexity of those unregulated pollutants which may pose a severe threat to human health and the environment.

Aliphatic Hydrocarbons

These are the simplest of organic compounds, containing only hydrogen and carbon. The alkanes and cyclic alkanes do not have double bonds and are relatively unreactive. The alkenes, cyclic alkenes, and dienes contain one or more double bonds and are more reactive. The alkynes have triple bonds, may be reduced to alkenes by the addition of hydrogen, or can form aldehydes or ketones upon the addition of water.

At the ambient concentrations of these hydrocarbons expected outside of the synfuel plant boundaries, no direct toxicity is expected. Volatile aliphatic hydrocarbons are not considered to be carcinogenic, mutagenic, or teratogenic, but some alkanes may be co-carcinogens or tumor-promoters.

The following are examples of aliphatic hydrocarbons expected to be emitted from synfuel facilities:

A. Alkanes:

Methane	Pentane
Ethane	Alkanes (more than five carbon atoms
Propane	Cycloalkanes
Butane	Polycycloalkanes

B. Alkenes

Ethylene	Pentene
Propylene	Cycloalkenes
Butylene	Polycycloalkenes

C. Dienes

Butadiene	Hexadiene
Pentadiene	Cyclohexadiene
Cyclopentadiene	Polycyclodienes

D. Alkynes

Acetylene
Propyne

Benzene and Related Compounds

This group contains simple aromatic hydrocarbon compounds such as benzene and compounds with simple substitutions at one or more positions on the benzene ring. Some of the long-chain alkylated benzene derivatives are weak tumor promoters.

The following are examples of simple aromatic hydrocarbon compounds expected to be emitted from synfuel facilites:

A. Benzene and Alkylbenzenes

Benzene	Alkylbenzene (greater than three carbon atom substitution)
Toluene	Ethylbenzene
Xylene	Styrene
Propylbenzene	

B. Naphthalene and Alkylnaphthalenes

Naphthalene	Dimethylnaphthalene
Methylnaphthalene	Acenaphthalene
Ethylnaphthalene	Alkylnaphthalenes (greater than two carbon atom substitution)

C. Biphenyls and Diphenyls

Biphenyl
Diphenylmethane
Diphenylethane

Polynuclear Aromatic Hydrocarbons

Compounds in this category have two or more fused benzene rings. Since this group contains numerous known and suspected carcinogens, it has received considerable attention from health researchers. Minor changes in structure among the compounds can drastically affect respective genotoxic properties.

The following are examples of the kinds of polynuclear aromatic hydrocarbons expected to be emitted from synfuel facilities:

Anthracenes	Benzopyrenes
Phenanthrenes	Benzochrysenes
Benzanthracenes	Benzoperylenes
Pyrenes	Fluorenes
Benzophenanthrenes	Fluoranthenes
Chrysenes	Benzofluoranthene
Triphenylenes	Binaphthyl
Perylenes	Picene

Heterocyclic Nitrogen Compounds

Compounds within this group contain a nitrogen atom as a member of an aromatic carbon ring. Many compounds within this group are presumed to be carcinogenic to some degree. As is the case for polynculear aromatic hydrocarbons, minor changes in chemical structure can drastically affect oncogenic properties of these compounds.

The following are examples of the kinds of heterocyclic nitrogen compounds expected to be emitted from synfuel facilities:

Pyridines	Pyrroles
Quinolines	Indoles
Benzoquinolines	Carbazoles
Tetrahydroquinolines	Dibenzocarbazoles
Acridines	

Heterocyclic Sulfur Compounds

Compounds within this group contain a sulfur atom as a member of an aromatic carbon ring. Since these are derived from the five-membered ring called thiophene, this group is also termed the "thiophenes".

Many members of this group are considered to be carcinogens or co-carcinogens. Only recently has this group been rigorously studied with respect to toxicity and measurement techniques.

The following are examples of the kinds of heterocyclic sulfur compounds expected to be emitted from synfuel facilities:

Thiophenes
Benzthiophenes
Dibenzthiophenes
Naphthiophenes
Benzonaphthiophenes

Heterocyclic Oxygen Compounds

These compounds contain an oxygen atom as a member of an aromatic carbon ring. They are derived from a five-membered heterocyclic ring called a furan or from xanthene which contains a six-membered heterocycle ring.

Furan is considered highly toxic if inhaled or absorbed through the skin. Other members of this group also may be toxic, but have not been thoroughly studied.

The following are examples of the kinds of heterocyclic oxygen compounds expected to be emitted from synfuel facilities.

Furans
Benzofurans
Dibenzofurans
Naphthofurans
Xanthene

Phenolic Compounds

These compounds contain a hydroxyl group (-OH) attached directly to an aromatic ring. Simple phenols readily degrade under biological activity; however, complex phenols tend to be highly toxic and many have co-carcinogenic properties. They are a major component of aqueous wastes from synthetic fuel facilities. Complex phenols can be found in the particulate phase of airborne pollutants.

The following are examples of the kinds of phenolic compounds expected to be emitted from synfuel facilities:

Phenols	Catechol
Cresols	Indanol
Naphthol	Phenylphenol
Resourcinol	Hydroxyfluorene

Alkylphenols (greater than one carbon atom substitution)

Alcohols

Alcoholic compounds contain a hydroxyl ion (-OH) attached to one of the three carbons of an alkyl group. Unlike phenols, these compounds do not contain a benzene ring.

These compounds can be found in aqueous airborne aerosols or in wastewaters. They can contaminate potable water and impair aquatic biota by interfering with membrane permeability.

The following are examples of the kinds of alcohols expected to be emitted from syfuel facilities:

Methanol
Ethanol
Propanol
Alcohols with more than three carbon atoms

Aldehydes, Ketones, and Quinones

These compounds contain a carbonyl group (C=O). Because of the tendency of the oxygen atom to acquire electrons, they react readily. In aldehydes the carbonyl group is attached to a simple aliphatic or aryl hydrocarbon group. Quinones are cyclic and contain two carbonyl groups (cyclic ketones contain one carbonyl group). These substances are known to be toxic. Some, e.g., certain quinones of benzo(a)pyrene may be co-carcinogens.

The following are examples of the kinds of compounds within this group expected to be emitted from synfuel facilities:

Formaldehyde
Benzoquinone
Naphthaquinone
Anthraquinone
Phenanthraquinone

Carboxylic Acids and Derivatives

These compounds contain a carboxyl group (a hydroxyl ion attached to the carbon of a carbonyl group) which is attached to an alkyl or an aryl group. They readily react with bases to form salts and, by means of replacement reactions, form amides and esters as derivatives.

These diverse substances may account for 10-26 percent of the benzene-soluble organic matter associated with urban pollution. A few are known to be toxic in high concentrations; but only limited information is available regarding their biological activity at the low levels at which they normally exist in the ambient environment.

The following are examples of the kinds of these substances expected to be emitted from synfuel facilities:

Formic Acid
Acetic Acid
Propanoic Acid
Butanoic Acid
Methylpropanoic Acid
Pentanoic Acid
Methylbutanoic Acid
Hexanoic Acid
Acetates (esters)
Phthalates (esters)
Amides

Amines and Nitrosamines

These compounds are volatile and considered a major health concern with respect to synthetic fuel facilities. Aromatic amines in particular are highly toxic. Many, together with numerous nitrosamines are considered to be carcinogenic. They can be absorbed through the skin or inhaled.

The following are examples of the kinds of compounds within these groups that are expected to be emitted from synfuel facilities:

Primary Aromatic Amines (having more than two rings)
Aliphatic Nitrosamines
Aromatic Nitrosamines

Cyanide Derivatives

These substances, termed "nitriles", contain a carbon atom joined to a nitrogen atom by a triple covalent bond. They hydrolyse in water to form carboxylic acids. With heat they can decompose into toxic cyanide vapors. They also can act as catalysts in the formation of toxic nitrosamines.

The following are examples of the kinds of these substances expected to be emitted from synfuel facilities:

Thiocyanates
Nitriles

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Trace Elements

In above normal concentrations, many trace elements are toxic. They can accumulate in food chains, and exist primarily in combination as particles or adsorbed on other particles in air and water media.

The following are examples of trace elements expected to be emitted from synfuel facilities:

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bromine
Cadmium
Cerium
Cesium
Chlorine
Chromium
Cobalt
Fluorine
Gallium
Germanium
Iridium
Iron
Lead
Magnesium
Manganese
Mercury
Molybdenum
Nickel
Potassium
Rubidium
Samarium
Scandium
Selenium
Silicon
Silver
Sodium
Strontium
Tantalum
Terbium
Thallium
Thorium
Tin
Titanium
Tungsten
Vanadium
Ytterbium
Zinc
Zirconium

Hazardous Gaseous Substances

A number of hazardous gases can be emitted from synthetic fuel facilities.

These gases, e.g., hydrogen sulfide, carbonyl-sulfide, carbon disulfide, hydrogen cyanide, and gaseous vapors of metal carbonyls can be highly toxic in concentrations possible within the workplace environment. Extremely toxic metal carbonyls persist only for a few seconds, unless a high concentration of carbon monoxide exists. Highly odoriferous and persistent mercaptans are considered harmless at normal ambient levels detectable to the olfactory organs.

Examples of potentially hazardous gaseous substances expected to be emitted from synfuel facilities are:

Hydrogen Sulfide
Carbonyl Sulfide
Carbon Disulfide
Hydrogen Cyanide
Ammonia
Metal Carbonyls
Mercaptans (tiols)

Radioactive Materials

Due to the sedimentary origin of coal and oil shale many radioactive elements, e.g., uranium and thorium and their decay products, have become concentrated (by a factor of ten) within the strata. Further concentration can occur during cleaning, processing, and waste concentration. Various routes can lead to both water and airborne transmission through the ambient environment. These radioactive materials can be inhaled or passed along the food chain and injested.

Those radioactive compounds which potentially could be released into the ambient enviornment from synthetic fuel facilities include:

Uranium-238 and daughter products
Uranium-235 and daughter products
Thorium-232 and daughter products
Radon 220 and 222

Monitoring of Pollutants

Altogether, on the order of magnitude of 1,000 different potential pollutants have been identified in various synfuel waste streams (at the pilot, demonstration, and commercial scale). We know very little about the health risks associated with many of these substances due to the lack of adequate data derived from assessment studies. Such studies have not been conducted because the release rates of specific pollutants or "source terms" are inadequately known, since few large scale commercial plants exist at the present time. For the most part, relatively little health effects or air and water quality information is available for those specific pollutants and classes of pollutants identified through studies of pilot and demonstration plant emissions and process chemistry. This is because such emissions are composed of many unconventional pollutants which have not been the subject of required compliance monitoring conducted by similar industries.

However, we can sample and measure these diverse emissions. Most can be collected within the same sample and analyzed together by means of "off-the-shelf" equipment and recognized procedures, such as the use of a gas chromatograph coupled with a mass spectrometer that

is linked to a computerized data base. For a few parameters of concern, state-of-the-art methods are in the formative stage. Nonetheless, even these procedures can provide meaningful information on the relative magnitude of pollution associated with specific compounds.

Regulation of Pollutants

The statute which most directly relates to these emissions is the Energy Security Act (Public Law 96-294). The relevant sections 131(e) and 143(b) require that a monitoring plan be submitted by project sponsors receiving financial assistance from the Synthetic Fuels Corporaiton. All monitoring is to be conducted in accordance with the plan. The plan for the monitoring of environmental and health related emissions shall be developed after consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, and appropriate State agencies (specific wording provided).

The wording of the Act appears to not limit such monitoring only to currently regulated pollutants. The phrase "environmental and health related emissions" certainly can relate to emissions of those elements and compounds previously cited.

As the synthetic fuels industry develops, we probably shall see only a few commercial facilities receiving financial assistance from the Synthetic Fuels Corporation. Most, perhaps as many as 160 (based on a recent EPA survey), will be financed entirely by the private sector. The monitoring requirements in the Energy Security Act will not extend to these privately financed facilities.

However, should the Synthetic Fuels Corporation, working with EPA and DOE, require comprehensive monitoring, a precedent could be established. Privately financed plants could be persuaded to develop similar monitoring plans to alleviate negative public perceptions concerning the health hazards associated with synfuel facilities and to demonstrate good environmental stewardship. Such information can be useful to allay public perception of the existence of harmful plant emissions.

The collected monitoring information will be useful from the standpoint of identifying "red flags" with respect to health hazards. Currently there are no ambient standards against which the levels of unregulated pollutants can be compared. If a problem is observed, abatement measures probably will be on a voluntary basis by industry.

ENERGY SECURITY ACT

(PL 96-294)

Section 131 (e) - *"Any contract for financial assistance shall require the development of a plan, acceptable to the Board of Directors, for the monitoring of environmental and health related emissions from the construction and operation of the synthetic fuel project. Such plan shall be developed by the recipient of financial assistance after consultation with the Administrator of the Environmental Protection Agency; the Secretary of Energy; and appropriate State agencies."*

Section 143 (b) - *"Contracts for the construction or operation of any Corporation construction project shall provide for the monitoring of the environmental and health related emissions from the construction and operation of such project. Such monitoring shall be conducted in accordance with a plan developed by the contractor after consultation with the Administrator of the Environmental Protection Agency and the Secretary of Energy."*

Section 126 (b) - *...within four years the Corporation shall present to Congress a comprehensive strategy which shall include "findings, based upon accompanying comprehensive reports, regarding synthetic fuel projects which received financial assistance prior to submission of such comprehensive strategy to the Congress with respect to" ..."the environmental effects associated with each such project as well as projected environmental effects and water requirements".*

For the Synthetic Fuels Corporation, how the collected data will be summarized, evaluated, and transmitted back to the Corporation, is yet to be determined. However, under the Act [Section 126(b)], the Corporation is obligated to report back to Congress within three years from now with a comprehensive reporting of the environmental effects associated with each project supported by the Corporation (see specific wording).

Research Priorities

Introduction

There are a number of research priorities associated with the development of synthetic fuel technologies. I shall summarize these. Most of my information is derived from a recent report sponsored by the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies. The report is entitled "Health and Environmental Effects of Synthetic Fuel Technologies: Research Priorities". Copies are available while supplies last from The MITRE Corporation (1820 Dolley Madison Boulevard, McLean, Virginia 22102, Attn: Records Resources) which served as Executive Secretariat for the Committee. Copies also are available as report number PB81-212474 from the National Technical Information Service (NTIS), U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. I am submitting copies of this report as an appendix to this written statement.

The report is an assessment of the health and environmental effects research priorities related to coal gasification and liquefaction and oil shale development. It reflects the subjective judgments of well-chosen research scientists in relevant disciplines. These scientists reviewed the results of workshops conducted in 1978 on coal gasification and liquefaction and oil shale, background information on related Federal research, and comments by relevant Federal agencies. The scientists prepared a listing of current research needs according to major areas of concern. These were categorized as to generic, region-specific, or process specific research. For the latter category, various scales of development were addressed for two exemplary processes: SRC (solvent refined coal) II and above ground oil shale retorting. Subjective judgments were used to prioritize the research tasks and assess the adequacy of current research.

Health Effects

Definition of worker exposure to toxic substances within the workplace is critical. Research is needed to characterize process

streams and end products of those technologies approaching commercialization--to reach an understanding of the magnitude and circumstances of fugitive (related to uncontrolled or malfunction conditions) and planned (related to startup, shutdown, maintenance, or operational conditions) emissions. In addition, attention should be paid to predicting the consequences of various industrial accidents.

Of critical importance to defining worker exposure is the need for the development of valid, reliable, standard, and economically available instrumentation and monitoring techniques. Such development should include real time measurement, direct reading capability, and mobile samplers. A clear understanding of interference agents, artifact compounds, and other effects arising from storage time and conditions as well as the development of techniques to overcome sample transport and storage problems, constitute a high priority area for research.

Epidemiology is an important discipline with regard to occupational exposures. Prospective morbidity studies need to be initiated utilizing information on existing workers in synthetic fuel facilities as the beginning of a registry. Standardized non-biased methods for analysis of epidemiological data need to be developed. As new synfuel plants are sited, an epidemiological data base should be initiated to assess whether the general public surrounding these plants face higher health risks than the population at large.

In the mainstream of occupational research and development, certain ongoing work needs to be expanded. Improved techniques designed to limit the exposure of skin and lungs to toxic agents need to be developed. Existing methods used to quantify exposures need to be evaluated with respect to efficiency and validity. Resulting from this evaluation, new methods may need to be developed. New protective clothing and respirators are needed to protect the worker against sorbents, catalysts, airborne and condensed polycyclic organic materials, and other potentially hazardous substances associated with synthetic fuel facilities.

Animal toxicology, particularly inhalation research, is critical to the assessment of worker and public exposure to airborne chemicals. Little research has been conducted in this area with respect to pollutants from synthetic fuel facilities, largely because the lack of appropriate materials in amounts sufficient for testing and to the relatively high costs associated with whole animal testing. Inhalation exposure research needs to center on the development of methods and instrumentation to expose animals to test materials and to determine the dose achieved in animal inhalation

studies. Life span inhalation exposures need to be evaluated for possible carcinogenicity, toxicity, effects on the reproductive system and on morphological and physiological development of the fetus, and for chronic lung disease.

Animal testing with respect to dermal exposure is also critical. Workers may be exposed through skin contact particularly during the pilot and demonstration phases of synfuel development when numerous valves, flanges, and fittings are tested and evaluated.

Short term bioassays are an important, relatively low cost, tool for determining the toxicity, carcinogenicity, etc., of chemical compounds. These tests will need to be continually applied to new process materials as the emerging technologies of the synfuels industry are refined and approach commercialization.

Short term cell transformation bioassays using rodent and human fibroblasts and epithelial cells need to be developed and validated. Microbial short term mutagenesis tests are well developed, but should focus more on the quantification of synfuel complex mixtures and on correlation with the test results of mammalian systems. Non-mammalian cell systems (e.g., spiderwort, corn, and insects) need to be developed for assaying complex mixtures. Such tests will be useful in assessing the effects of aqueous leachates, combustion products, and vapor emissions. These are needed for application in the monitoring of synfuel facilities.

The state of the art of risk assessment needs to be advanced in order to adequately predict human health risks associated with various synfuel development strategies. (EPA has begun a comprehensive, well-structured program of synfuels risk assessment which may be substantially limited due to a current round of budget cuts).

Air Quality

Of fundamental importance is the need for acquisition of baseline air quality information in geographical regions which will be subjected to intense synfuel development. This information can be acquired only before development takes place.

Synthetic fuel processing facilities will likely emit pollutants such as carbonyl sulfide, nitrogen containing polynuclear aromatic compounds, oxygen-containing organics (phenols, carbonyls, ethers, peroxides), mercaptans and organosulfates, and many coal tar related compounds. These substances will require the development of unique, relatively low cost, reliable instrumentation and techniques for

sampling and analysis. Quality control (an outgrowth of this research), in terms of the validity of basic data, is critical to an understanding of air quality effects and to the usefulness of the collected data in research studies classified under the health effects and ecological research areas.

An important research area where results are needed prior to the development of western synfuel resources is techniques for complex terrain modelling and monitoring. (This EPA program also may be substantially limited due to a current round of budget cuts).

Ecological Effects

Important research is related to cumulative effects which are identified through regional studies, such as those associated with western oil shale development. Another region where such research is needed is western Kentucky, where large scale coal development is planned. Pre-operational ecological baseline data collection is an important part of regional studies. This information can only be acquired before development takes place.

An area of immediate importance is ecological test and evaluation development. Advancing the methodology in this area will increase the capability for identifying potential environmental impacts, providing quality assurance and ensuring the successful completion of subsequent effects studies. Many of the techniques under development are critical to the successful completion of important effects assessment studies.

Broad areas of high priority research associated with terrestrial research relate to discharges to the atmosphere and to changes in land use patterns and secondary impacts. Of critical concern is the effect of long term, chronic exposure of natural biota and agricultural crops to low levels of pollutants unique to synthetic fuels, especially to biotic systems (e.g., semi-arid desert biota and grasslands) which usually have not been stressed by man-induced pollutants.

Cumulative Effects

The societal problems posed by the emerging synfuels industry must be viewed within a broad context. There are many development activities which will be occurring simultaneously with synfuels development. Such development may be on adjacent tracts of land and small communities may be affected by the development activities of several technologies. The often cited example is the development of energy in the West, primarily within the states of Utah, Wyoming, and

Colorado. But, similar diverse development activities can affect states in the Ohio River basin and in Appalachia. Accelerated energy, defense and natural resources development will place a severe strain on local, state, and regional entities in dealing with the cumulative effects of multi-faceted development. Within Colorado, EPA and state and local agencies are beginning to make a substantial collective effort to deal with these problems.

Generally, state and local officials and planners lack the regional and national overview of the interactive and cumulative societal impacts of both the private sector and government-sponsored and regulated development activities. Federal agencies have differing perspectives (and diverse programs), but generally have a wide overview of such problems. Yet, interactive and cumulative effects of simultaneous, large scale development activities are not sufficiently understood. Much relevant information exists, but it is fragmented among several Federal agencies and many community officials and planners are often unaware of its existence.

For the broad areas of the West, the causes of cummulative impact on society are well known (see examples). The impacts themselves not only result from specific development policies, projects, and programs, but result from the interactive forces of multiple activities in a cumulative manner. Information on solutions is limited, but the problems of rapid population growth, unmet demands for basic facilities and services, institutional stress, and various forms of individual discomfort and discontent are well documented.

Of all the information on societal impacts associated with development, little is adequately disseminated to all potential users. Federal and state agencies and industry frequently study the same localities and issues, often with a lack of information flow between them. The localities themselves are not always provided with the results of these studies. In many cases the local perspective is not taken into account and cumulative impact is not addressed.

Federal outreach information programs have not been providing maximum benefit to impacted communities. The available assistance has been primarily for specific causes and effects (usually emergencies). Local officials often are not cognizant of appropriate mechanisms or contacts for acquiring technical information. The Federal information assistance usually is not coordinated or provided in an active, outreach manner.

The wide range of local, state, and regional entities capable of providing information assistance are hampered in their efforts as a

EXAMPLES OF CAUSES OF SOCIETAL IMPACT

(as exemplified in the western U.S., mostly in Wyoming, Colorado, Utah)

- Oil shale development
- Accelerated mining of western coals
- Uranium mining
- Regional water projects
- Oil and gas development (overthrust belt)
- Coal gasification and liquefaction
- Development of tar sands
- Construction and operation of new, large coal-fired power plants
- Construction and operation of MX Missile system
- Other development (e.g., western tight sands, geothermal resources, transportation systems, enhanced oil and gas recovery)

result of diversity of functions and jurisdiction, are separated geographically, not connected within a communication network, and have varying capabilities of technical expertise.

What is needed is an information coordination mechanism or information clearinghouse to help impacted communities (and the public) obtain, and the Federal government to deliver, available technical information. An initial action item leading to the development of such an information broker would be to define local, state, and regional information needs related to development problems and to identify specific sources of relevant technical information. This initial activity also would identify gaps in the availability of information at both Federal and local levels, and most importantly, would compile a who's who directory and index of existing information programs and resources as well as information users at both the Federal and state levels.

Once established, the clearinghouse could act as an information broker providing a timely means of communication among a network of Federal, regional, state, local, and other concerned entities for up-to-date information concerning development (and decommissioning) plans and status of both government (Federal and state) and private development projects. One of the important functions of the clearinghouse would be to respond to local and state inquiries for technical information. Ancillary functions of such an entity could be the sponsorship of regional public forums and workshops and to provide information on long-term population and resource development projections.

Can existing clearinghouse entities provide this function? Perhaps so, but first, existing information dissemination entities will have to be identified. It will have to be detemined how responsive they are in providing information on societal impacts. It will have to be determined how existing clearinghouse entities can be expanded or linked together. Finally, and most important, it will have to be determined if any of the existing entities can act in an outreach manner (purposefully assembling contacts in order to form an information loop).

Coordinated Research

The techniques proposed for recovering oil from U.S. tar sands can also be applied to recovery of deep light oils and heavy oils, and enhanced recovery of oil shale by in situ techniques. Some heavy oils are produced in California and Texas by thermal methods (and are included in conventional oil reserve estimates). Gas from geopressured brines, eastern shales, western tight sands, and deep

basins is expected to be extracted through the application of fracturing and the use of drilling muds--methods that are also employed to recover the resources named above.

These resources are classified by various Federal agencies under different programs, depending upon the agency's convenience and statutory mandates, pricing categories for the resource, and definition of conventional versus unconventional resources. As an example, research in support of heavy oil may be categorized as conventional crude oil research by one agency and as support of synthetic fuels development by another (the Energy Security Act classifies undeveloped heavy crude as a synthetic fuel). As a result, many duplicative development and research strategies are taking place. Often, identical generic and region-specific health and environmental research activities can apply to several technologies. A research coordination strategy is needed which will enable relevant generic, regional, and process-specific research to be brought to bear on solving similar fossil fuel health and environmental effects problems.

Many energy-related, health and environmental effects research activities are not technology specific. Examples in the health area include the development of methods and instrumentation for bioassay studies for the study of the effects of exposure of energy-related pollutants, determination of the specific effects of particular compounds on various body systems, the development of measurement and sampling protocols for energy pollutants under ambient conditions, and, the development of protective clothing and equipment. Similar examples can be cited for research on pollutant effects on fauna and flora, air quality, and water quality.

There is a need to identify research needs which can simultaneously serve a number of technologies and a common set of generic research needs that can serve as the basis of a coordinated Federal health and environmental research program.

Having completed its mission under the 1977 Presidential environmental message, the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies did not address issues which cut across several technologies (see list of committee sponsored reports). Identifying and removing redundancies and filling gaps was not in its purview. This need requires a new impetus to initiate a strong and viable coordinated multi-agency program of health and environmental effects research.

REPORTS SPONSORED BY THE FEDERAL INTERAGENCY COMMITTEE ON
THE HEALTH AND ENVIRONMENTAL EFFECTS OF ENERGY TECHNOLOGIES

MITRE REPORT NUMBER	TITLE	NTIS REPORT NUMBER	NTIS PAPER COPY COST (as of July 1981)
M78-58	Health and Environmental Effects of Coal Gasification and Liquefaction Technologies: Background Material for a Workshop (1978)	PB 296 708	$20.00
MTR-79W136	Health and Environmental Effects of Oil Shale Technology: A Workshop Summary and Panel Reports (1979)	PB 297 096	$20.00
MTR-79W137	Health and Environmental Effects of Coal Gasification and Liquefaction Technologies: A Workshop Summary and Panel Reports (1979)	PB 297 618	$26.00
MTR-7915901	Health and Environmental Effects of Coal Technologies: Background Information on Processes and Pollutants (1979)	PB 299 040	$35.00
MTR-7915902	Health Effects of Coal Technologies: Research Needs (1980)	PB 81-118796	$17.00
MTR-80W348	Health and Environmental Effects of Synthetic Fuel Technologies: Research Priorities (1981)	PB 81-212474	$18.50
MTR-79W15903	Environmental Effects of Coal Technologies: Research Needs (1981)	PB 81-220824	$18.50
MTR-81W77	Health and Environmental Effects of Oil and Gas Technologies: Research Needs (1931)	PB 81-228124	$48.50

Copies on microfiche also are available from NTIS. The cost per microfiche copy is $3.50 as of July 1981.

These reports sponsored by the Federal Interagency Committee on the Health and Environmental Effects of Energy Technologies are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. Copies of the most recent reports are available from the Executive Secretariat for the Committee while supplies last. Contact Richard Brown or Records Resources, The MITRE Corporation, 1820 Dolley Madison Boulevard, McLean, Virginia 22102

SUMMARY AND RECOMMENDATIONS

Complexity of Pollutants

A highly diverse set of parameters exist with respect to emissions from synthetic fuel facilities. Most pollutants are currently unregulated. A comprehensive and responsive monitoring program is needed at each large commercial synfuel facility. The emphasis of each monitoring plan should be on the sampling of such emissions at appropriate routes of movement and by identifying their composition and potential hazard. Such monitoring can lead to the understanding of such pollutant movement into the ambient environment and the development of abatement and control strategies. The media which act as pathways of pollutant movement which require monitoring include the unsaturated zone, surface aquifers, and deep aquifers for leachates; surface waters for pollutants derived from leachates and controlled discharges; and the atmosphere for contaminants associated with airborne fugitive and controlled emissions.

Recommendation 1

That comprehensive source and ambient monitoring of both regulated and unregulated pollutants be required to be an integral part of the operation of large commercial synfuel facilities. This should include baseline (preconstruction) monitoring. That the collected data be in the public domain (i.e., be made available for public scrutiny). That a Federal agency, e.g., the U.S. Environmental Protection Agency, be given oversight responsibilities for the data collection process.

Research Priorities

A number of high priority health research needs must be met prior to the development of a domestic synthetic fuel industry. These focus on worker exposure to toxic substances and the development of adequate protective equipment and monitoring devices. Prospective morbidity studies need to be initiated along with bioassay studies. Cutting across all health research areas is the need for a viable and responsive risk assessment program.

In the areas of air quality and ecological effects, acquisition of pre-construction, baseline information is critical, together with the development of reliable techniques to monitor the unique pollutants associated with the synfuels industry.

Since the Committee report submitted with this statement was developed in FY 1980 using FY 1979 information on research

activities, new information is needed to account for interim changes in light of technological advances changing synfuels development strategies, and recent adjustments in research budgets within pertinent Federal agencies.

Recommendation 2

That an interagency task force (can be the same as that cited in the following recommendations) be instructed to review all synfuels health, environmental, and socio-economic effects research within Federal agencies for the purpose of identifying redundancies, gaps, and priorities with respect to the timeliness of information needed to understand and solve health and environmental problems posed by the emerging synfuels industry. The outcome of the review should be an integrated and timely national program of research with definite targets and outputs designed to meet emerging problems. The program should specify a five-year plan which Congress can review for the purpose of assigning multi-year funding commitments and oversight reviews.

Cumulative Effects

A great number of health, environmental, and socio-economic (collectively termed societal) impacts face individuals, local communities, states, and regional areas as a result of the cumulative effect of the concomitant development of many emerging and conventional technologies, spanning non-fuel minerals, uranium, the conventional fuels of oil, gas and coal, synfuels, tar sands, geothermal, and defense development. Affected individuals and communities require technical information to understand and solve the problems facing them.

Recommendation 3

That an interagency task force be charged with the responsibility of conducting a feasibility study and making recommendations for the development of a clearinghouse to broker technical information among Federal and local entities. The feasibility study should identify local, state, and regional entities concerned with societal impacts; define technical information needs for these entities; identify existing sources of information; define relevant types of information which can be obtained from those sources; identify gaps in the availability of technical information versus needs at the local, state, and regional level; and identify and evaluate the usefulness of existing clearinghouse or organizational and institutional entities to coordinate an outreach effort of providing relevant technical information.

Coordinated Research

Health and environmental energy-related research is an indispensable part of a viable Federal research and development program. Industry is not interested in research for research sake. It will limit its information gathering capabilities to those activities in which it has a vested interest, e.g., site operation and compliance monitoring. If applied health and environmental research is to be done, it will have to be conducted within the Federal government.

Recommendation 4

In these times of fiscal constraint, it is all the more important to identify and to remove redundancies in research activities, not only within an agency, but among agencies involved with similar research. By removing redundancies the "freed" funds can be reallocated to fill gaps in high priority areas.

Such coordinated research will need to have the impetus of a statute. This is needed for two reasons: (1) no one agency can perform this task alone, and any agency will need a strong mandate to interact with other agencies when each has a unique mission guiding its funding allocations and budget submissions; and (2) with funding cutbacks, agencies have attached priorities only to activities mandated under statutes or regulations.

The instructions to the agencies must be explicit with respect to cooperative budget submissions and research plans. For energy-related research, the interagency task force should at least be comprised of the Environmental Protection Agency and the Departments of Energy, Health and Human Services, Interior, and Agriculture (for biomass research). In order to avoid dominance by any one entity, the Executive Office of the President (either Council on Environmental Quality or Office of Science, Technology, and Policy) should be identified as a non-voting chairman. This would link the coordinated research efforts directly to the needs of implementing national policies and would assure parity among the agencies of the task force.

This task force also could be mandated the responsibility of overseeing the clearinghouse functions identified in Recommendation 3 and in assuring a timely and effective research response to address the health and environmental concerns related to the emerging synfuel industry as identified in Recommendation 2.

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Mr. FUQUA. Thank you, Dr. Brown.

Dr. Massey, the previous panel indicated that health risks associated with shale production were no more likely than any other associated with traditional petroleum products. Could you comment on that?

Dr. MASSEY. Let me preface my remarks before I do that.

Mr. FUQUA. Mr. Scheuer asked a similar type of question.

Dr. MASSEY. Yes; I was listening carefully as the answer came back.

My principal expertise—and I am not trying to dodge the question, but I will come back and work on it—is in coal gasification and coal liquefaction and not in shale oil.

With that preface, I would really like to recall something that one of the speakers mentioned. I believe you asked for follow-up discussion on the point at the time.

The speaker indicated that there was an inclusion of hydrotreating in their shale oil onsite processing. As you may have noted in my formal remarks, there is a very significant relationship between hydrotreating and the toxic properties of synthetic liquids. This is a well established fact in coal liquefaction; my suspicion of its relevance in shale processing is reasonably confirmed by the speaker's comments today.

With that as a backdrop, I am not at all surprised that he would claim low toxicity for shale product, make that comment, nor do I know of any particular reason why I would not support it. If I looked at the data, my suspicion is I would follow and come to the same kind of conclusion, remembering the caveat that I have not actually seen that data.

One of my responsibilities in the DOE program for some time has been to try to establish trends and relationships and functional behavior between process characteristics and the toxicity of effluents so as to reduce the need for programs to continue to repeat themselves in massive characterization programs from one technology to the next.

It is with that background, that I approximated the answer to your question.

Mr. FUQUA. Dr. Chartock, would you like to comment on that also?

Dr. CHARTOCK. In terms of hydrotreating, the question really is how much hydrotreating do you perform and at what cost?

Relative to most petroleum products, the heavier fractions of oil shale and liquids have been shown to be relatively carcinogenic. If you do hydrotreat those, a lot of that carcinogenicity can be mitigated.

Mr. Chittum was indicating that he would hydrotreat it sufficiently so that most of the carcinogenicity would be removed.

That really is in part an economic question—certainly in terms of bench scale or testing in the laboratory, one can hydrotreat the devil out of something and remove most of its toxicity. That certainly is the case with coal liquids. There is really an economic tradeoff there. The general consensus is that a high degree of hydrotreating is uneconomic with coal liquids, and one has to do something with those heavy fractions in order to use them onsite or to

control their use in a way that the public will not be exposed to those materials.

In terms of the broad notion about whether or not coal liquids or petroleum activities are more or less an environmental problem than oil shale deals with where this activity is taking place and how intense the activity will be in the future in a given geographic location.

At one time a few years back the general consensus was that a 400,000-barrel-per-day industry would be adequate, or could be an acceptable industry in the oil shale region of Colorado.

Now that has been boosted up to around 800,000 or 900,000 barrels.

I think there really is a value judgment there as to how much or how intensely the industry can be developed within certain kinds of environmental guidelines.

I do not know if I responded to your question or not, but those are my views.

Mr. FUQUA. I think so.

It is an issue we all have questions about.

Dr. Brown, you mentioned approximately 160 new facilities to be inaugurated in the next few years. I do not remember the time, but that is not totally important.

You also talked about monitoring those.

Would we need to modify the Clean Air Act to adequately cover that? Who would do the monitoring? Do we have the monitoring technology available?

Dr. BROWN. It would require in some way an amendment to a statute. The Clean Air Act may not be the proper statute, although it could be utilized, because we are talking about water as well as air emissions.

The Energy Security Act—the whole act itself, or the main portion of it relating to synthetic fuels—relates to the Synthetic Fuels Corporation per se.

These 160 I mentioned are derived from an EPA survey of facilities that are actively being explored in terms of their development.

The figure was about 169. I would estimate about nine—or not many more—within the next few years would actually obtain funding by the Synthetic Fuels Corporation.

The 160 may be a low number, because recent estimates by private firms who track these types of projects for coal gasification and liquefaction have estimated higher numbers.

Who would monitor and how would it be handled? I have explored this in terms of capabilities of both source and ambient monitoring for a typical facility. Such monitoring would be integrated with process monitoring of the process itself being accomplished by these industries—both feed stock and product—together with required source monitoring.

The additional source monitoring and the ambient monitoring with an integrated laboratory would probably not be very expensive relative to the scheme of things if a proper laboratory were established.

I am proposing then that each facility would monitor in compliance with guidelines for source and ambient monitoring which

would be released by a Federal agency. I am proposing the Environmental Protection Agency be that agency.

It would have to be an amendment to some statute.

I foresee perhaps problems with attaching this as an amendment to the Clean Air Act. There are a lot of other amendments being considered to the Clean Air Act. It might be some time before all this can come together, in terms of having one revision of the Clean Air Act.

We are very soon, I think, going to be concerned with the construction of some of these large facilities.

As I mentioned, baseline construction is an important factor in the monitoring process.

I have really no answer in terms of what statute it should be attached to; but I do believe that if we have the data, the public sector, the industry, and regulatory agencies can perceive if there are problems, where they are, and what the bad actors are in terms of constituents.

At that point in time, and I foresee this probably about 4 or 5 years down the line, we will see in many parts of the country the nonexistence of problems that we fear today.

I also believe that in certain parts of the country we may have very high concentrations of metals and also various organic constituents that may present problems we are not aware of today and only through monitoring can we see them.

Mr. FUQUA. Thank you.

I am going to have to excuse myself. I have another meeting to attend, but I want to thank you for being here.

I am going to turn the meeting over to Chairman Scheuer to conclude.

I want to thank all of you for being here and for your contributions today.

Mr. SCHEUER. Ms. Schneider?

Mrs. SCHNEIDER. I wonder if any one of you could give me some specific technological answers as to what kind of control technologies might be necessary to do the type of monitoring we are talking about?

Dr. BROWN. Monitoring is really a last-ditch activity.

In terms of controlling pollution from synthetic fuel facilities, efficient process control is a first step.

Second, we move into the realm of good housekeeping practices.

This is most important in terms of control of many of these organic emissions we are concerned with.

In some facilities, as much as 90 percent of the organic emissions we have been concerned with are fugitive emissions in that they are released in noncontrolled ways, mostly from leakage from valves and flanges and fittings and spilled pools of liquids and so forth.

Adequate, periodic, and frequent maintenance of these valves and flanges and so forth really involves good housekeeping and keeping track of these emissions and solving the problems as they develop. This controls a lot of the emissions—these fugitive emissions that we are concerned with.

The next step gets into control technology, which you mentioned.

The last step is the ambient monitoring that we have been talking about. That is the last step before effects are seen in terms of either health or the environment.

I would like to back up from monitoring and say that monitoring really is our last chance in order to intercept these emissions before effects can be seen.

The real answer lies in control technology, but I propose even before that, in good housekeeping and efficient process controls.

Mrs. SCHNEIDER. I wonder if you could also give me an example of an interagency task force which may currently exist and might be a good model to use in the construction of an interagency task force for this purpose of monitoring synthetic fuel development.

I would like to look at that from two points of view—one from obtaining scientific background data and also from the point of view of acting as a clearinghouse, which were two of the areas you touched on.

Is there any interagency task force now that you think would be a great model to follow?

Dr. BROWN. Honestly, not to my knowledge—no.

Mrs. SCHNEIDER. That is what I was afraid you were going to say.

As I sit on the Environment Subcommittee also, we have had testimony about various task forces. It always appears to be a good idea, but we are having a difficult time finding a working model.

Dr. BROWN. The working model largely comes about naturally through a mandate.

Many of the task forces I know of are unwilling to go the extra step, because they have no clear authority or mandate in that particular arena.

Some task forces with lead agencies will take the path pretty much of the lead agency. You get very much of a disinterest or lack of concern with the other agencies in terms of participation. The lead agency always takes the lead.

Interagency coordinated research and information transfer, in my mind, to be successful, means cooperative effort, where no one agency has a vested interest or dominance.

I propose these to be linked then, for example, to the Executive Office of the President; so they are linked not only to policy and direction and can respond with flexibility to changes in national strategies and programs, but have a definite entity to report to and also can be required to make annual or periodic reports to Congress as well. There is no agency of that nature in my mind.

The EPA energy passthrough program that was initiated about 6½ years ago mainly was a mechanism to funnel money to other agencies to sponsor control technology and health and environmental effects research.

That has been successful over the years.

Because it was a passthrough mechanism, EPA was pretty much evolving into a lead role within that particular entity.

The Federal Interagency Committee, which I have been involved with, had no clear purview in this area. Its function was only to identify effects problems and address the question whether the current research is adequate or not but not to do anything about the problem. That requires a definite mandate.

Mrs. SCHNEIDER. I think we see our job ahead of us.

Do you see any role for the Council on Environmental Quality in the coordination or whatever in this particular task force effort?

Dr. BROWN. I mentioned that a link to EOP could be CEQ. It also could be OSTP.

The CEQ's direction these days, as I understand it, is fairly limited—primarily to looking at global issues and dealing with NEPA and so forth.

Mrs. SCHNEIDER. That is why I was asking you for some additional job descriptions, so we can help them out and give them an idea of what we think CEQ ought to be doing.

Dr. BROWN. I propose that this would be a major activity of CEQ, both from a clearinghouse information broker standpoint and information transfer, especially environmental and health information, coordination of Federal health environmental effects research being second, and acting in a very timely and efficient manner and getting our act together, as the dust settles from the fiscal year 1982 budget cuts and before the wind comes for 1983 on the synfuels research effort.

This would be required of CEQ, but it would have to be backed by a mandate, through a statute, or something like that.

Mrs. SCHNEIDER. You also mentioned the need for worker exposure studies and morbidity studies and risk analysis. With the current discussions about changing OSHA, do you have any particular comments you would like to make?

Dr. BROWN. I think I am more concerned about the lack of funds coming to NIOSH and NIEHS which have played an important role in the synfuels effort, for example, in developing industrial hygiene practices and identifying problems affecting workers and getting into the arena of developing protective equipment—clothing, for example—and others, where the benzopyrene and other harmful pollutants would not penetrate clothing.

All this is coming to a very sudden halt as the cutbacks have affected the energy passthrough program to these agencies. Those are the only entities so far—NIOSH and NIEHS—that have really addressed this particular issue.

Until we understand what the worker problems are and what to do about them, entities such as OSHA, or other regulatory agencies, can not carry the ball from there.

That is one of the major significant gaps today—worker protection within the synthetic fuel facilities.

Mrs. SCHNEIDER. Mr. Chairman, I would like to have the opportunity, since we have to go vote and I have another appointment, to leave the record open so that we might have an exchange of some specific dollar figures that you three gentlemen might be in a position to recommend to better define the impact of the current round of budget cuts upon your proposals you have so very well articulated today.

Mr. SCHEUER. I am going to rule without objection that the record be left open and opportunity be provided to all of the members to submit questions in writing.

Mrs. SCHNEIDER. Thank you.

Mr. SCHEUER. I am going to submit my questions in writing, because we only have another minute or two before we have to leave.

[See appendix.]

Mr. SCHEUER. Mr. Weber, do you have any questions?

Mr. WEBER. No, thank you, Mr. Chairman.

Mrs. SCHNEIDER. I would just like to thank the witnesses, because I think that the testimony which has been presented today has been completely analytical and thorough. I think it certainly gives us a terrific framework to move from there and I look with enthusiasm to working with you.

Mr. SCHEUER. I could not agree more. This was an excellent panel, as was the last.

There are certain very grave inconsistencies in the testimony between the first and second panel. I think we will have some questions for both panels.

I want to thank you for your patience and for your excellent testimony.

APPENDIX

QUESTIONS AND ANSWERS FOR THE RECORD

Union Oil Company of California

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Carleton B. Scott
Director, Environmental Sciences

November 20, 1981

Congressman Don Fuqua
Chairman, Subcommittee on Energy
Development & Applications
U.S. House of Representatives
2321 Rayburn House Office Bldg.
Washington, D.C. 20515

Congressman James H. Scheuer
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Resources, Agriculture and
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Dear Chairmen Fuqua and Scheuer:

The attached information is submitted in response to questions posed in your letter of October 29, 1981 and during my testimony before the Subcommittee on Energy Development and Applications and the Subcommittee on Natural Resources, Agriculture and Environment held on October 1, 1981.

I trust you will find the information adequate. Please call me if you require any further information or clarification.

Sincerely,

CBS:llg

Attachment

I. QUESTIONS IN THE OCTOBER 29, 1981 LETTER

Q1 What resources, in personnel and funds, are you now devoting and are prepared to commit to environmental research associated with shale oil production. Please state your answer in terms of the type of research (e.g., control technology development, monitoring, health and ecological effects, etc.), total expenditures (annual and over the life of the venture) , and as a percentage of estimated total project cost?

A1 Exhibit VI attached to the October 1, 1981 testimony provides a detailed list of environmentally related research work associated with the shale oil project that has been undertaken by Union Oil Company.

While it is not possible to accurately quantify the portion of the expenditures devoted solely to "environmental research associated with shale oil production," our Science and Technology Division estimates their expenditures for the referenced items to be in the order of $17,300,000.

In addition to the expenditures of the Science and Technology Division, the Energy Mining Division is also conducting and/or actively considering a number of environmentally related research programs dealing with issues including:

Meteorology and Air Quality Model development

Hydrology and Water Quality

Waste Treatment and Disposal

Vegetation and other land reclamation studies

Biological Research to determine toxicological effects of shale oil and shale derived products

The total expenditure on these items is expected to be in order of $6,500,000.

Q2 What are your environmental research needs and how can the needs be best satisfied by industry and the Federal Government.

A2 Referring to the testimony presented on October 1, 1981, the two areas that could benefit from more research in the near-term future involve the questions of visibility measurement and air quality modelling for the purposes of evaluating and protecting air quality increments. These areas should be addressed by the Federal Government in a cooperative mode with the affected industry. Union is actively engaged in working with the Environmental Protection Agency on these matters.

Other research on pollution control and process technology will be conducted by the companies in the shale business and by the developers of pollution control technology and devices. The Federal Government should be involved only to the extent necessary to establish fixed objectives and regulatory limits for the companies to attain.

Q3 Against what industrial facilities can you compare shale oil extraction and refining processes to determine shale oil emissions exposures.

A3 Emission Factors from industrial facilities have been developed and updated by the Environmental Protection Agency in their publication known as AP-42. Shale Oil extraction and refining can be broken down into segments to which known emission factors can be applied. For those steps which have not yet been included in the emission factors compilation, a series of emission tests should be conducted to develop such factors. It is our understanding that the Environmental Protection Agency is beginning a series of tests to determine emissions from synfuels including shale oil.

Q4 Please provide to us a copy of the report or a citation which claims that more CO_2 is emitted from coal conversion plants than from petroleum refineries.

A4 The point made on CO_2 production from synfuels at the October 1 hearing was that CO_2 produced from synfuels operations is not significantly higher than conventional fuels.

To illustrate this point, the following table presents the results of our calculations which show the release of CO_2 from shale oil processing using the Union Retort B process compared to equivalent amounts and processing of California Heavy Crude and Light Arabian Crude:

	Pounds of CO2/BBL Crude (Syncrude)		
Case	Shale Oil (Retort B)	Heavy California (Thermally Enhanced Recovery)	Light Arabian
Retorting	210	--	--
Enhanced Recovery	--	356-687	--
Upgrading	120	126	108
Subtotal	330	482-813	108
Combustion of Products	955	955	955
Total	1285	1437-1768	1063
Relative	1.21	1.35-1.66	1.0

These data show that synfuels are just like conventional fuels when they are burned; CO_2 emissions would be the same. Production of synfuels, on the other hand, could release additional amounts of CO_2 as a result of producing hydrogen that may be needed if the product has a relatively high hydrogen-to-carbon ratio (like gasoline), and the raw material has a relatively low hydrogen-to-carbon ratio (like coal). Upgrading or refining CO_2 production are relatively equivalent.

These increases, however, need to be compared against the increasing amounts of CO_2 emissions coming from other sources, including:

a) CO_2 resulting from the additional work needed to produce and refine the increasingly heavy domestic and foreign crude oils;

b) CO_2 resulting from production of hydrogen (hydrocarbon plus water to give hydrogen plus CO_2) needed to upgrade conventional fuels to meet tightening environmental standards for sulfur, nitrogen and particulate matter;

c) CO_2 resulting from generation of power and use of chemicals needed to operate pollution control equipment such as stack gas scrubbers and NO_x controls; and

d) CO_2 resulting from the steadily increasing consumption of fuel worldwide.

The net result is that any increases in CO_2 from synfuel sources are likely to be undetectable because of the myriad of other, much larger sources.

II. OTHER QUESTIONS ARISING AT THE OCTOBER 1, 1981 HEARING

Q1 What is the number of acres devoted to spent shale disposal.

A1 For Phase I (12,500 Tons/Day and 10,000 bbl/day) 312 acres are devoted to spent shale disposal over a 22-year time period in accordance with the Colorado Mine Land Reclamation Board Permit.

Q2 What need is there for further regulation of so-called unregulated pollutants.

A2 Exhibit II attached to the October 1, 1981 testimony provides a list of the environmental laws which apply to projects including shale oil development. These laws plus companion state laws and the associated regulations provide a comprehensive framework by which all so-called unregulated pollutants are in fact regulated to a significant degree. It is difficult to find any credible area where an environmental or health loophole exists.

EXHIBIT VI

RECENT OIL SHALE DEVELOPMENT PROGRAM AT

UNION SCIENCE & TECHNOLOGY CENTER

I. AIR POLLUTION CONTROL

A. Retort Makegas H_2S Removal

1. Stretford Process Evaluation

a. 1976 Test Work

Purpose: evaluate H_2S removal efficiency, chemical losses and sulfur quality.

b. 1980 Test Work

Purpose: evaluate chemical losses.

2. Unisulf Process Evaluation

a. 1979-1980 Test Work

Purpose: evaluate H_2S removal efficiency, chemical losses, sulfur quality and effect of gas contaminants on process operability.

B. Retort Makegas COS Removal

1. Dry Phase COS Conversion

a. 1978 Test Work

Purpose: evaluate operating conditions and COS conversion efficiency to H_2S using hydrotreating catalysts.

2. Liquid Phase OCS Conversion

a. 1980-1981 Test Work

Purpose: evaluate COS conversion efficiency to H_2S, chemical byproduct buildup and operating conditions using an aqueous phase hydrolysis solution.

C. Retort Makegas NH_3 Removal

1. Ammonia Absorption From Makegas

a. 1980-1981 Test Work

Purpose: determine operating parameters for absorption of NH_3 from retort makegas using an aqueous solution.

II. HAZARDOUS SOLIDS CONTROL PROGRAM

A. Arsenic Removal From Shale Oil

1. 1973-1976 Process Development Program

Purpose: develop solid phase absorbants for removal of arsenic from shale oil.

2. 1976-1980 Demonstration Program

Purpose: demonstrate arsenic removal in large scale pilot plants.

III. VEGETATION PROGRAM FOR RETORTED & DECARBONIZED SHALE

Parachute Creek, Colorado

1966 - Started vegetation work on Retort A ash disposal site, continues as natural study with no further irrigation or fertilization of the alfalfa and other plants.

1974 - Started decarbonized shale revegetation studies with Agronomy Dept. of Colorado State University. Installed eight valley plots and six plateau plots.

1975 - Installed fourteen new valley plots for retorted shale studies by CSU personnel.

- All valley plots instrumented with salinity sensors neutrons probe access tubes for moisture profile determinations and thermocouples on the west-facing Retort B plots for temperature measurements.

- Mulching, leaching, fertilization and seeding of the valley and plateau plots performed during 1974 and 1975.

- Erosion control studies performed by U.C. Davis utilized various mulching applications. Erosion control studies started on valley 2:1 slopes in 1975 and continue to date.

1979 - Constructed 14 new 1.7:1 south-facing retort B plots with CSU personnel below the old demonstration plant site. These new plots were leached, mulched, fertilized and planted by CSU personnel in 1979.

- All studies on the valley, plateau and new 1.7:1 plots continue with yearly reports issued by CSU personnel.

Brea Research Center Studies

1973 - Greenhouse and lysimeter studies began to assist Retort A disposal pile tests and to develop methods for vegetating decarbonized shale.

1975 - Constructed large 16' x 52' concrete lysimeter to study compaction, permeability, leaching, mulching, fertilization and vegetation of retorted shale.

- Filled with 148 tons (dry weight) of quenched retorted shale from Unit 60 pilot plant in 8" layers and compacted to average dry density of 87 lbs/cu ft.

- Contains a 4:1 south-facing slope (16' x 24'), a flat center surface (16' x '6.5'x6' deep) and a north-facing 1.7"1 slope (9.8' x 16').

- Now planted with Colorado native species that are periodically fertilized, irrigated and evaluated.

1976 - Constructed three concrete, west-facing, 4:1 slope lysimeters for decarbonized shale studies. South and center plots were filled with decarbonized shale produced from 34 gpt raw shale and the north plot was filled with retorted shale made from 34 gpt shale.

1977/79 - Native Colorado species were seeded on lower halve of the three plots and three barley crops were grown on the upper halves after leaching, mulching, and fertilizing treatments.

1979/79 - South plot was emptied of decarbonized shale and filled with 41 gpt retorted shale.

- All three plots now contain native Colorado species that are periodically irrigated, fertilized and evaluated for growth performance.

EXHIBIT II

MAJOR FEDERAL ENVIRONMENTAL AND HEALTH LAWS

APPLICABLE TO SYNTHETIC FUELS PROJECTS

- Clean Air Act
- Clean Water Act
- Resource Conservation and Recovery Act
- Safe Drinking Water Act
- Federal Land Policy and Management Act
- Antiquities Act
- Wilderness Act
- Toxic Substances Control Act
- Surface Mining Control and Reclamation Act
- Endangered Species Act
- Energy Supply and Environmental Coordination Act
- National Environmental Policy Act
- Coastal Zone Management Act
- Water Resources Planning Act
- Nonnuclear Energy Research and Development Act
- Noise Control Act
- Archaeological Resource Protection Act
- National Historic Preservation Act
- Occupational Safety and Health Act
- Rivers and Harbors Act
- Fish and Wildlife Coordination Act

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ROGER D. CHITTUM
SENIOR VICE PRESIDENT
ENVIRONMENTAL AFFAIRS

DIRECT TELEPHONE NUMBER
213/552-7438

October 29, 1981

Mr. William T. Harvey, Jr.
Minority Facilities Specialist
Committee on Science and Technology
U. S. House of Representatives
Washington, D. C.

Dear Mr. Harvey,

At the hearing on synthetic fuels, environmental research and development held on October 1, 1981, by the Sub-Committee on Energy Development and Applications and the Sub-Committee on Natural Resources, Agricultural Research and Environment, Tosco was asked to supply for the record some additional information about spent shale disposal. Specifically, we were asked to report the size of the projected spent shale pile to be generated by the Colony Shale Oil Project and also to indicate the size of existing spent shale disposal areas upon which tests have been made.

The spent shale disposal area for the commercial life of the Colony project will occupy approximately 900 acres. Existing Colony spent shale disposal areas and test plots occupy approximately two acres.

I trust that this information is responsive to the request. If not, please do not hesitate to call on me for additional information.

Sincerely yours,

Roger D Chittum

RDC/vt

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ROGER D. CHITTUM
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November 19, 1981

The Honorable Don Fuqua
Chairman,
Subcommittee on Energy
Development & Applications

The Honorable James H. Scheuer
Chairman,
Subcommittee on Natural Resources,
Agriculture and Environment

Committee on Science and Technology
U. S. House of Representatives
Suite 2321
Rayburn House Office Building
Washington, D. C. 20515

Dear Mr. Fuqua and Mr. Scheuer,

I am pleased to respond to your letter of October 1, 1981 requesting additional information in connection with the October 1, 1981 hearings on "Synthetic Fuels Environmental Research and Development." Responses to your specific questions are contained in the attachment.

We appreciate the opportunity to participate in the work of your subcommittees on this subject.

Sincerely yours,

Roger D Chittum

RDC/vt
Enc.

Responses by R. D. Chittum to Supplemental Questions
for the October 1, 1981 Hearing on Synthetic Fuels
Environmental Research and Development

1. Q. We would like to have the specifics on your plant monitoring capabilities including a description of sampling methods, data collection, data evaluation, and process correlation.

   A. The environmental monitoring program for the Colony Project is described in Appendix D to the Project Monitoring Agreement, a copy of which is attached. Details are being developed as part of the final design of the Project.

2. Q. How many acres will be used in the module and the full scale project for the waste pile?

   A. The spent shale embankment as permitted by the Colorado Mined Land Reclamation Board will cover 900 acres. Spent shale research, experimental, and demonstration sites currently cover approximately two acres.

3. Q. What resources, in personnel and fund, are you now devoting and are prepared to commit to environmental research associated with synthetic fuels production? Please state your answer in terms of the type of research (e.g., control technology development, monitoring, health and ecological effects, etc.), total expenditures (annual and over the life of the venture), and as a percentage of estimated total project cost.

   A. Tosco's current synthetic fuels research programs are keyed to producing clean liquid and gaseous fuels from oil shale, coal and other materials. A basic premise of our research is that consideration of environmental factors should be built into the technologies from the start. To accomplish this, environmental and health and safety specialists are involved in the design, execution, and review of R&D programs, and environmental controls tend to be integrated into the process itself rather than appearing only as single-purpose control equipment. Current and planned environmental research spans spent shale disposal and reclamation, health effects, water quality and treatment, and waste disposal. Research is conducted through a variety of mechanisms, including trade associations, working agreements with government agencies, in-house laboratories, contractors, and, as in the case of the Colony Project, partly with other companies. This variety of funding mechanisms, combined with the fact that it is impossible to segregate process R&D from environmental research makes it unfeasible to provide an aggregated estimate of environmental R&D expenditures.

4. Q. What are your environmental research needs and how can these needs be best satisfied by industry and the Federal Government?

A. Tosco's approach to the development of new process technology treats environmental protection as an essential, integral process component. Accordingly, it is our view that the burden of designing and carrying out research programs on the health and environmental effects of synthetic fuels development should be borne by industry and not by the federal government. This does not mean that we are opposed in principle to government sponsored research, but we are not presently aware of any particular needs which cannot be met by industry.

Exhibit D

ENVIRONMENTAL MONITORING REQUIREMENTS FOR THE COLONY SHALE OIL PROJECT

A. Monitoring requirements under PSD permit pursuant to Clean Air Act.

1. Random sampling for particulates in spring, summer and fall at the plant site and terminal area during construction.
2. Annual tests during the first three years of operation of: mine vent particulate emissions; secondary crusher particulate emissions; preheat stack HC, SO_2, NO_x and patriculate size distribution; elutriator SO_2, NO_x and particulate size distribution; shale wetter particulates size distribution; sulfur plant SO_2 and total sulfur compounds; hydrogen furnace SO_2, NO_x and particulates; and utility boiler SO_2, NO_x and particulates.
3. Continuous monitoring of SO_2 and NO_x from a single representative stack of the preheat system, elutriator, sulfur plant (SO_2 only), and hydrogen furnaces.
4. Continuous monitoring (including startup, shutdown and steady state operations) of particulates from a representative stack on the secondary crusher and the shale wetter.
5. Performance testing of the primary crusher baghouse for particulates.
6. Upwind/downwind particulate sampling including size data at the processed shale pile for one week periods during spring, summer and fall over at least two years.
7. Ambient monitoring at one site for meterology, SO_2, NO_x and particulates size, and at two more sites for particulates, for at least five years.
8. Visibility data collection for one year of construction and three years of operation.

B. Monitoring requirements under MLR permit pursuant to Mined Lands Reclamation Act.

1. Photographic documentation of revegetation annually until five years after plant abandonment.
2. Investigations on native forb establishment in conjunction with studies to be carried out on experimental vegetation plots. The purpose of such studies will be further refinement of the reclamation plan.
3. Monitoring for presence of trace elements in vegetation in two stages. Stage I monitoring will be conducted in test plots grown on solid stockpiles. Stage II monitoring will be conducted as soon as practicable, on test plots in reclaimed areas on the spent shale disposal site.
4. Monitoring to evaluate the concentration and migration of soluble salts within the spent shale, including chemical analysis of any salt crust which may form in the surface of the spent shale pile.
5. Investigations of the geologic, hydrologic and surface hydrologic characteristics of the proposed spent shale disposal area.
6. Additional studies of the physical characteristics of spent shale, its sheer strength and the material density to verify the accuracy of material properties assumed in the stability analysis area design of the spent shale disposal area.
7. Subsidence monitoring to monitor the following parameters:
   (a) ore zone and overburden rock mechanics properties;
   (b) ground surface deformation and angle of draw;
   (c) soil mechanics properties of surficial material; and
   (d) hydrogeological properties of bedrock and surficial materials.

8. Processed shale embankment monitoring to monitor the following parameters:
   (a) fill density/moisture and compaction;
   (b) fill integrity and slope configuration; and
   (c) precipitation and groundwater infiltration and migration.
9. Monitoring of erosion rates on revegetated terraces and slopes in the spent shale disposal area.
10. Monitoring of the quality of significant sources of surface and subsurface waters in the Davis Gulch area.
11. Monitoring of the quality and quantity of waters used to moisturize, leach and irrigate the spent shale disposal area.
12. Monitoring of the quality of run off and leachate from the spent shale disposal area.
13. Monitor the rate of new soil development in the spent shale zone as evidenced by root penetration and development, initiation of microbiological processes and accumulation of silt or organic matter. (This is a requirement of this Agreement and not the MLR permit.)

C. Monitoring requirements under special and conditional land use permits issued by Garfield County, Colorado.

1. Project workforce including place of residence, type of training, number of school children, and other similar information as requested by the Garfield County commissioner.

D. Monitoring of occupational exposure to the following substances and conditions.

1. Carbon monoxide
2. Carbon dioxide
3. Hydrogen sulfide
4. Sulfur dioxide
5. Arsenic
6. Alpha quartz
7. Dust
8. Noise
9. Metal fumes — welding operations
10. Nitrogen oxides
11. Diesel particulate
12. Hydrocarbons
13. Heat and cold

In addition to the above monitoring, broad spectrum monitoring for other toxic substances, including those which are carcinogenic or teratogenic, using bioassay techniques, shall be performed. Each area of the workplace shall be examined by an industrial hygienist, during and after construction, to identify potential health hazards.

E. Worker Health.

A medical surveillance program will include pre-employment histories and physical examinations, followed by regular physical examinations, including appropriate X-rays and laboratory tests. Particular attention will be focused on skin, lungs, urinogenital organs, blood and blood forming tissues, cardio-vascular system, liver, central nervous system, and any additional problems identified in the medical history or examinations. During the first few years of operation, all employees will be scheduled for a physical examination once each year. Current plans are to continue with annual check-ups in the ensuing years as well, but in later years some decrease in frequency of examination may be appropriate for some employees, depending on such factors as employee age and exposure level. All such records shall be retained for the life of the Project. If an industry-wide oil shale worker registry program is established, the Borrower shall participate in such program.

F. Employee safety will be promoted by education and training, the development and implementation of safe operating procedures, machinery and equipment guarding, requirements for use of personal protective equipment and auditing by different levels of management to assure ongoing accident prevention efforts.

The University of Oklahoma at Norman

Science and Public Policy Program

November 30, 1981

The Honorable Don Fuqua,
Chairman, Subcommittee on Energy
Development and Applications; and
The Honorable James H. Scheuer,
Chairman, Subcommittee on Natural
Resources, Agriculture and Environment
Committee on Science and Technology
U.S. House of Representatives
Suite 2321 Rayburn House Office Bldg.,
Washington, D.C. 20515

Dear Mr. Fuqua and Mr. Scheuer:

Enclosed are my responses to your supplemental questions from the hearing on Synthetic Fuels Environmental Research and Development. I hope the answers are useful in addressing the vital national issues of providing adequate information to develop the nation's fuel resources in an environmentally acceptable manner.

I want to thank you for the opportunity to respond to your questions. I would be pleased to provide further information at your request.

Sincerely yours,

Michael A. Chartock

Michael A. Chartock
Research Fellow, Science and Public
Policy Program; and Associate
Professor of Zoology

MAC:etl

ANSWERS TO SUPPLEMENTAL QUESTIONS

for the Hearing on

SYNTHETIC FUELS ENVIRONMENTAL RESEARCH AND DEVELOPMENT

by

Dr. Michael A. Chartock
Research Fellow, Science and Public Policy Program
and
Associate Professor of Zoology
University of Oklahoma
Norman, Oklahoma

Provided on
December 1, 1981

For the

House Subcommittee on

Energy, Development and Applications

and

Natural Resources, Agriculture and Environment
Committee on Science and Technology

ANSWERS TO SUPPLEMENTAL QUESTIONS

by

Dr. Michael A. Chartock

INTRODUCTION

I want to thank the Chairman and committee members for the opportunity to respond to additional written questions as indicated following my testimony on October 1, 1981. Your supplemental questions are:

(1) Please provide your opinions on the R&D programs needed to define any health and safety problems in the synthetic fuels industry and how they can be integrated with process development activities. Cost and scheduling information would also be appreciated. Specifically we would especially like your views on how this could be done for coal gasification technology and both surface and MIS oil shale extorting; and

(2) What control technologies or process refinements need to be developed for synthetic fuels and what information is needed to guide such development?

I want to indicate that a comprehensive response to these questions entails a program review examining important private sector initiatives in both technology development and environmental R&D and the efforts of federal agencies, universities, and nonprofit research groups. In the case of federal developments and other efforts, this program review represents following a continually moving technology "target".

My approach in response to these questions will be to identify selected R&D programs responsive to high risk areas, problematic

conditions, and potential generic programs that represent deficiencies in Department of Energy, Environmental Protection Agency, and National Institute of Health Research areas for 1980-1981 prior to budget and program reductions necessitated by the new FY 82 budget, and the further reductions now discussed in November of this year. These added programatic reductions such as the potential diminished EPA programs in evaulation of effects of diesel emissions on human health, delays in developing fugitive emissions standards, and delays in hazardous waste standards will likely intensify the confusion and uncertainty in developing a synthetic fuels industry. The reduction in EPA programs, the dismantling of the Department of Energy, and the reduced level of anticipated synfuels support by the Synthetic Fuels Corporation makes the development of a coherent and timely environmental R&D plan difficult.

The responses are based on studies conducted by the Science and Public Policy Program of the University of Oklahoma on synthetic fuels from coal and oil shale that were initiated in 1974. These studies were supported by the National Science Foundation, the President's Council on Environmental Quality, the U.S. Environmental Protection Agency, and the Office of Technology Assessment with the support of the University of Oklahoma. However, the opinions expressed are mine and do not necessarily reflect those of any specific group or agency.

I. R&D PROGRAMS NEEDED TO DEFINE HEALTH AND SAFETY PROBLEMS

Research needs summarized in these answers have been developed through a comparison of existing and potential problems and issues

against energy and environmental research programs. They are based primarily on the needs for developing adequate health, safety, and environmental standards and to inform necessary environmental decisions. Factors important in identifying the needs include:

- The level of confidence in information on which a decision is based;
- The magnitude of the problem, both in geographic scope and in terms of the numbers affected;
- The relative risks involved;
- The managability, reversibility, or ability to deal with the problem; and
- Timeliness in responding to developing synfuels facilities.

Significant environmental and health policy problem areas included are:

- Water quality and availability;
- Air quality;
- Solid waste and land use; and
- Health effects.

In sections below, I summarize major research needs primarily related to oil shale and coal gasification in the West, and coal utilization in other areas of the nation. These research needs are primarily related to the policy and issue areas of water, air, ecology, and health information. At the end of the sections a summary table is provided and I make some concluding remarks on the general need for federal R&D support for synthetic fuels environmental research.

In the sections below I indicate relative cost and scheduling information. Relative cost categories are small, less than 5 million dollars expenditure annually, moderate, 5 to 25 million dollars annually, and large, 25 million dollars or more annually. These cost categories do not include administrative expenses. I do not believe that more precise estimates are appropriate at this time without more detailed program review. The timeliness of research is approximated on a near-, mid-, and long-term scale, representing the periods over which the research should be conducted. These time frames represent 5 years, 5 to 10 years, and 10 to 20 years. Again, the following discussion is not comprehensive, but highlights selected major problems identifiable at this time.

A. Water Quality and Availability Needs

Information needed to assess synthetic fuels environmental issues and policy options for dealing with water availability and quality in the U.S. is limited by inadequate water policy data and the methods for analyzing and utilizing information. The environmental policy needs require an ability to develop a range of technical estimates on the availability and quality of surface and groundwater, both on a local and a regional basis. These estimates provide a basis for the evaluation of policy alternatives for siting plants, and evaluating synfuel facility effects. The important questions that need to be addressed include:

- What are the water requirements and effluents from coal gasification and oil shale technologies under

alternative design and operating conditions? Some research is now being conducted that responds to this need.[1]

- What are the probable ranges of water availability among the major streams and river basins in the coal and oil shale bearing states, and what major stream flow variations may occur?

- What are the ranges of water quality and availability under different watershed development conditions, and what are the critical factors affecting potential variations in water quality?[2]

- What are the possible changes that may occur in eastern and western water law, and what affect may this have on the distribution of water and its availability to large scale synthetic fuel development?

- What are the attitudes that are likely to emerge among the major water users including:
  - private industry
  - state government
  - Indians
  - federal government?

- What is the relationship between trade-off of water use for different economic sectors and the economic and cultural characteristics of the Western and Eastern U.S.?

In order to respond to these questions, both technical research on water quality and availability, and institutional research on

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[1]For example see Gold, Harris, et al. 1977. Water Requirements for Steam-Electric Power Generators and Synthetic Fuels Plants in the Western United States. Washington, D.C.: U.S., Environmental Protection Agency; Science and Public Policy Program, University of Oklahoma. 1981. Energy From the West: A Technology Assessment of Energy Resource Development. Norman: University of Oklahoma Press.

[2]An example of responses to this need include Yampa River Basin studies conducted by the U.S., Geological Survey, and Yellowstone River Basin Level B studies sponsored by the Missouri River Basin Commission. See Steele, T. D., et al. 1976. An Environmental Assessment of Impacts of Coal Development on the Water Resources of the Yampa River Basin. Colorado and Wyoming--Phase I Work Plan, U.S., Geological Survey Open File Report 76-367.

water resources standards, laws, rules, and legislation need to be undertaken. As described below, because a great deal of technical research has been completed, most of the research needs identified emphasize uncertainties associated with fragmented water policy systems.

A.1 Technical Research

Some of the problems and issues dealing with water arise from limited or conflicting knowledge about synthetic fuel facilities, existing environmental conditions, and transport processes and effects. I believe important gaps exist in the following areas:

Water Consumption Data Review. Industry, government, and independent research efforts have conflicting data on water use and consumption from synthetic fuel facilities, and what alternative process designs can do to reduce this consumption. This data is critical to resolve issues about limited water availability, especially in the Western U.S., for population and energy growth and agricultural interests. Findings of the Science and Public Policy Program indicate that water availability may reach a crisis level near 1990-2000, and that temporary crises can occur earlier depending on rainfall and runoff conditions.[1] Synthetic fuel facility water consumption can have local effects on a variety of present users, and affect environmental variables such as stream salinity and the distribution of wetlands.

The gap is not that existing studies are not undertaken, but rather that they are often conflicting.[2] I do not advocate conducting additional studies or monitoring until the factors that significantly influence data variability can be systematically identified and defined. In part, this is an institutional problem: industry,

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[1]Science and Public Policy Program. 1981. Energy From the West: A Technology Assessment of Energy Resource Development. Norman: University of Oklahoma Press.

[2]For example: water consumption estimates for the Occidental Modified In Situ process range by a factor of 3 based on estimates from independent laboratories.

independent laboratories, and government agencies need to establish a systematic review of water consumption information.

Both DOE and EPA are funding water consumption research. However, existing research efforts need to emphasize trade-offs in the range of economic and process design operating conditions in order to evaluate the range of choices available. Thus, both industry and government sponsored research need to identify not only what water consumption now exist with present facilities, but the range of potential levels of water consumption under scales of economic and design assumptions. Federal agency research needs should be anticipatory and focus on the options for meeting water consumption requirements in this last decade of the century. A moderate level of funding would be appropriate over the near- to mid-term.

Holding Ponds and Discharge Assessment. Holding ponds are used in most energy conversion facilities in the Western U.S. to reduce or eliminate discharge of pollutants. In the Eastern U.S., continuous or intermittant discharges from coal gasification facilities is anticipated to be the most common practice. The impact of holding ponds is highly uncertain, potentially significant, and based on only limited information. The energy industry and other decisionmakers will need to continually review holding pond technology and the standards that make their use economically desirable. An integrated assessment of holding ponds is highly desirable, and should include the following components:

- Study of failure of holding ponds, including gathering of historical data on the kinds of failures and their significance, and the variables that are important, including rainfall, floods, and structural failure.

- Movement of pollutants through pond liners during normal operation. Studies of the EPA and the U.S. Geological Survey are beginning to assess this problem. A coordinated study in a variety of western environments needs to be initiated.

- Research on long-term stability of holding ponds needs to be extended to include studies on the fate of pollutants in holding ponds associated with other synthetic fuel conversion facilities. Research needs to begin on alternative procedures for maintaining surface stability and the prevention of leaching into groundwater.

- Water consumption by holding ponds in the Western U.S. is not adequately documented. Some responsible agencies suggest that holding ponds may increase water consumption

of energy facilities from 10 to 20 percent due to evaporation of waters that could be cleaned and treated with more costly technology. The process design requirements and economic costs of these alternative technologies needs to be made more available to decisionmakers.

- Institutional research is needed to examine the relationship of zero discharge goals in the 1972 Water Pollution Control Act Amendments and the choice of using holding ponds to achieve this objective. The adequacy of portions of the act that call for studies of water minimization technologies needs to be reviewed.

Generally the holding ponds assessment reflects the need of applying nationwide pollution control criteria to the unique water resources, and hydrological and environmental conditions found in the different regions of the U.S. Current information problems include: inadequate historical documentation of the magnitude and kinds of problems experienced; inadequate attention to technical alternatives for achieving zero discharge goals and their associated environmental and economic tradeoffs; and inadequate dissemination of existing information to local, state, and federal decisionmakers. A moderate level of funding would be appropriate over the near-term.

Wastewater Treatment Systems. Water quality impacts are also of concern with coal gasification and oil shale development because wastewater treatment designs are just emerging. Especially for coal synfuels, materials balances and performance data based on preliminary designs are not available. The wastewater treatment systems have not been tested against actual plant conditions, and several existing small pilot plants send waste streams to adjacent refineries. Performance data from wastewater treatment systems being designed for pioneer plants need to be evaluated prior to full-scale commercialization. Because of this uncertainty and the potential for failure in the wastewater treatment system, for example, due to poisoning of biotreaters, the wastewater treatment technology development should be a priority research activity. A moderate level of funding would be appropriate over the near term.

Other Water-Related Research. I believe that significant problems and issues exist in the following areas, and current and proposed research programs prior to FY 82 budget cuts have been responsive to them:

- Movement and fate of trace elements in surface and groundwater;

- Residuals monitoring of effluents from existing and emerging coal gasification and MIS oil shale technologies;

- Monitoring of western and coal-rich eastern and Gulf coast aquatic environments. EPA projects in conjunction with the Geological Survey are currently responding to some of these data needs;

- Assessment of stream flow and instream flow requirements. Basic research objectives are being established and progress is underway by agencies including the EPA, Geological Survey, Bureau of Reclamation, and the Office of Biological Services of the U.S. Fish and Wildlife Service; and

- Studies on riparian and stream-side habitat have been established by the Forest Service in the USDA.

In the future, some of these problems may intensify significantly, however. Of particular concern is percolation of toxic materials from gasifier ash; pollution of groundwater from a rapidly expanding program of MIS oil shale recovery; and dramatic reduction in stream flow from more intense energy and industrial development.

A.2 Policy Research

Although the technical analyses described above are important, many of the problems and issues about water quality and availability are institutional. Decisionmakers need to understand the fragmented and complex water policy "system" and the range of policy options.

Characterizing Water Policy Systems. Water has been a vital but scarce resource in the coal- and oil shale-rich western U.S. so that extensive legal and administrative controls have developed over its use. A range of specific research needs include:

- Documentation of existing federal controls over water and their effect on state and local decisions. Studies should investigate both the reduction of federal control as well as alternative extension of federal control, especially when national needs of energy supply are at issue. Although a variety of alternatives has been proposed, few detailed studies of alternatives have been conducted. These studies need to include not only environmental and economic trade-offs, but the effects on social and political institutions, and conflicts involved in implementation.

- Only limited information is available of actual water consumption patterns among competing social sectors during periods of drought. As competition for water intensifies during the 1980's, the need for systematically obtaining and disseminating this data will increase. A small to moderate level of effort would be appropriate over the near-term, closely coordinated with or implemented by the states.

Documentation of Existing Allocations. In most of the Western U.S., river basin areas rich in oil shale and coal have been overallocated. Few policymakers outside of state engineering offices have an adequate understanding of the status of existing allocations, or of the options for dealing with this problem. The kinds of information needed include the geographic and beneficial use distribution of water rights according to priority (senior and junior users), with an accounting of economic, social, and environmental characteristics of water user groups. Nationally a moderate level of effort would be appropriate over the near-term in close coordination with, or implemented by the the states.

Quantification of Indian Water Rights. One of the major uncertainties facing water policy in the Western states is the amount of water that can be reserved for federal and Indian purposes. This uncertainty has a major effect on social uncertainty in potential coal gasification sites around areas such as Farmington, New Mexico, and Decker, Montana, where unknown amounts of water are in the control of Indian tribes. In part, the limitation is overly political as some state interests may not wish to recognize potential rights and lose control over water. In part the limitation is technical and institutional, as an adequate methodology has not been developed that can be generally agreed upon for determining what water resources belong to Indian tribes. As water shortages intensify, and as Indian economic position grows, the need to quantify Indian water rights increases. A small level of funding would be appropriate over the near- to mid-term.

Alternative Institutional Management of Water Use and Pollution. In part, conflicts over management of water resources may be due to institutional separation of water consumption from water pollution. EPA, for example, has clear authority over water quality, and little or no authority over stream flows. In effect, it may require water intensive technologies that have zero discharge, yet in doing so, contribute to drying up stream beds. As indicated in the technical research section above, additional research is needed to develop pollution control technologies that minimize the need for water. A small level of effort would be appropriate over the near-term.

B Air Quality Research Needs

Data inadequacies and method limitations have been important uncertainties in air quality policy. For example, that the fate and effects of synfuel facility emissions over long distances or durations ultimately may have significant consequences on human health and the natural ecosystem is largely guesswork. Selected questions that need to be addressed include:

- What are the fates of pollutants that traverse long distances and durations;
- What is the burden to human health and the ecosystem from long-term exposure to trace elements and secondary pollutants;
- Are their modeling refinements that can be used to provide more accurate assessments about changes to visibility or the formation and transport of secondary pollutants;
- What are the interactive effects of numerous sources of emissions from energy facilities within a region? Most models trace plumes for a few miles, or don't identify conditions that might cause plume interactions from several facilities, as can be anticipated in the Piceance Basin in Colorado
- What procedures can be used to distinguish natural versus man-made pollutants, such as particulates and hydrocarbons;
- Does the range of existing implementation options, or possible new laws or regulations, consider an adequate range of trade-offs on facility size, coal types, environmental conditions, and economic effects;
- Do existing policies get adequately translated into action at the local level? For example, are variance procedures or patterns of start-up and upset conditions evaluated against environmental and economic criteria that attempt to achieve national goals?

These questions need to be addressed in order to adequately anticipate problems and prepare for the decisions that will have to be made if a large scale synfuels industry materializes.

B.1 Technical Research on Air Quality Effects

Technical air quality research by EPA receives major support, yet deficiencies still exist when needs are compared against current research programs. Selected deficiencies have been identified in technology characterization, environmental baseline data and monitoring, and evaluation of fate and effects of pollutants.

Upset or Failure Conditions Assessment. Emissions from facilities under alternative operating modes, including failure, start-up, and shut-down is generally only little understood. In part, this lack of information is institutional: existing regulations implementing the Clean Air Act do not require information on emissions during upset conditions. For example, in potential coal gasification sites in New Mexico (and in other states), energy companies will only be required to report on normal operating conditions.[1] During warm-up periods, for example, electrostatic precipitators are not in operation, and no data is required on emission levels. Specific technical studies are needed to document the frequency, duration, and emission levels during potential upset conditions for a range of operation and demand conditions. A moderate research effort would be appropriate over the near- and mid-term.

Segregation of Trace Elements in Energy Facilities. At present, data are highly incomplete on the material balance of trace elements in coal gasification process streams such as bottom ash, wastewater streams, acid gas streams, and stack emissions. Segregation of trace elements is highly dependent on the operating conditions of specific plants and on the composition of specific coals. Uncertainty surrounding this issue needs to be resolved to adequately predict facility performance. Data on segregation of elements is used to predict the performance of coal gasification facilities and is essential for modeling to determine pollutant exposure to the general public. This information is also important for evaluation of local solid waste disposal problems, including ash and sludges. Because predictive data on trace elements materials balance can be important to anticipate problems, this research area has special importance during the next five years, so that the magnitude of the problem of coal development during the next 10 to 20 years can be determined. A moderate level of research would be appropriate over the near to mid term.

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[1]Regulation 801, Upset, Breakdown, or Maintenance. State of New Mexico.

A Comparison Between Naturally Occurring and Man-Made Sources of Pollutants Needs to be Conducted and Evaluated for Areas Where Oil Shale and Coal Gasification Development Will Occur. Special attention needs to focus on the source and frequency of occurrence of natural hydrocarbons, particulates, and trace elements. In many instances the sources of pollutants are difficult to identify. Through procedures that monitor pollution under alternative atmospheric conditions, using sampling devices that both qualitatively and quantitatively characterize pollutants (such as using chromatographic analysis of hydrocarbons to determine the kinds of hydrocarbons present, and using particle characterization techniques) more useful data on the sources of pollutants can be made available.

It is difficult to determine how natural sources are modified by energy development and by other human activities. For example, soil erosion contributes to increased particulate levels, but existing pattern of erosion, and the potential for erosion control has received only limited attention. Basic studies are needed, especially when expansions of human populations and changes in agricultural activity seem likely in the coming decades. The present limitation with monitoring programs is in their lack of emphasis on qualitative characterization, as only the number of additional monitoring stations has increased recently.

The existing EPA Region VIII energy area monitoring locations to document oil shale development and coal utilization effects are adequate for criteria pollutants. However, the western oil shale and coal area monitoring program needs additional support to provide sampling devices that respond to questions that are likely to become increasingly important in the coming decades. Present equipment includes high-volume samplers, membrane samplers, SO_2 and NO_x bubblers and continuous samplers, and ozone sampling in selected locations. Additional monitoring for hydrocarbons should be included, together with sampling that discriminates between NO and NO_2 and NO_3 and trace elements that have been identified as potentially hazardous to health (e.g., mercury, fluorine, lead, arsenic). A continuing monitoring program at a moderate level of effort is needed.

Other Air Quality Research Needs.

- Data is critically needed to assess the impact of emissions characteristics of synfuel facilities on air quality with more informed data. Some of the data on emerging synthetic fuels facilities is proprietary and needs to be made available. In addition, process designs and pilot plants may not reflect emissions characteristics of commercial ventures or the reliability of control technologies. The DOE currently has established monitoring

programs for emerging energy technologies that respond to this data need. I also believe that the reliability of control technologies needs detailed risk evaluation.

- Measurement of trace organic emissions from process streams needs to be evaluated to assess occupational exposures, as well as exposure to the general public.

- Visibility monitoring needs to be expanded in areas with and without energy development. Studies sponsored by both EPA and the U.S. Forest Service are currently responding to the needs to establish baseline data and to document and predict changes in visibility.

- Long range transport models need to be developed to provide a basis for fate and effects studies at 100 to 1,000 miles from pollution sources. Efforts need to be sustained to refine models in research conducted by the National Oceanic and Atmospheric Administration, the EPA, and the DOE.

B.2 Policy Research Needs

As indicated below, federal research activities in air quality need to be more responsive to needs to reduce institutional uncertainties. This research area receives limited attention from agencies that have primarily technical missions, such as EPA and DOE.

Air Quality Management Among Levels of Government Needs to be Evaluated. Relatively little is known about how these rules and regulations get translated into action at the local level. An undercurrent in discussions with state and federal agency personnel is the occurrence of communications difficulties between levels of jurisdiction. For example, an environmental regulation agency official working at the county level in the oil shale region of Colorado expressed difficulty in dealing with officials in Denver after spending several months interacting with problems directly in the field.[1] Similarly, regional personnel assigned to state offices expressed difficulties in communicating back to headquarters, and regional staff had difficulties in establishing effective communication with Washington offices. The point of these observations is not that such conflict represents staff or institutional shortcomings, but rather that these problems have not received

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[1]Personal communication, Council of Governments staff, Western Colorado, June 1977.

systematic attention for potential review of policies, streamlining staff functions, or evaluation of innovative procedures that might facilitate meeting regulatory objectives rather than result in internal conflicts. I do not imply that a major introspective effort is needed on behalf of agencies such as EPA, rather a limited comparative study between states on implementation of agency objectives at the level of staff and industry performance should be undertaken. With the expansion of synthetic fuel development, such studies become increasingly more useful to anticipate the outcome of alternative air quality standards and implementation strategies. A small to moderate level of effort is needed over the near-term.

Assessment of Public Attitudes on Air Quality Trade-Offs. The evaluation of air quality policy has consistently involved an understanding of public attitudes on the energy, environment, and economic trade-offs, and the role of government.[1] Decisions have been based on perceived rather than measured attitudes. The evaluation of policy choices has been based on anonymous "westerners" or "easterners" with purported values, attitudes, and behaviors. Evaluation of attitudes and values needs to focus on the trade-offs individuals or groups are willing to make that accurately reflect the decisions that need to be made about maintaining or improving air quality in areas anticipating major synfuels development. A continuing research effort is needed, although at relatively small levels of effort.

Innovative Policies For Achieving Desirable Air Quality Outcomes. A comprehensive review of compliance sanctions and procedures for achieving air quality objectives needs to be made. Specific reviews could include:

- Decentralization of air quality standards. The existing policies are a patchwork of regulations which, by attempt, modify institutional processes through implementing Prevention of Significant Deterioration (PSD) class areas, and by designating areas as attaining or nonattaining, or by identifying air quality control regions. The underlying structure of this system needs to be reviewed. The differences within the coal and oil shale rich areas alone provide significant justification for a comprehensive review of national air quality standards.

- Review of penalty and incentive procedures to achieve outcomes. Requirements for Best Available Technology (BAT), provisions for fines, and existing sanctions and

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[1]Science and Public Policy Program. 1981. Energy From the West: A Technology Assessment of Energy Resource Development. Norman: University of Oklahoma Press.

enforcement procedures need to be reviewed. Some evidence suggests that these procedures limit the development of innovative technology, and that utilities or other industries simply pass costs to consumers to comply with the law rather than attempt to optimize environmental and economic benefits.

- Redesignate air quality control regions and other jurisdictional divisions. Existing air quality control regions do not reflect the need to manage the long range transport of pollutants. Redesignation is not an immediate problem, but the growth of energy development and new technical findings on long range transport suggest that existing air quality control jurisdictional divisions may not achieve the most effective trade-offs in controlling quality. A moderate policy research effort over the near term would be appropriate.

Assessment of Uncertainty in Timing and Delays. Existing procedures involve extensive delays, some of which are associated with implementing air quality objectives. Costs involved in timing and delays are passed on to consumers, and have been institutionalized within both industry and government. Policies to reduce timing and delay need to receive attention over the near term. A small funding effort would be appropriate.

C. Land and Ecological Research Needs

Of particular importance is quantifying ecological effects and assigning priorities to ecological problems. Of particular significance are the following questions that need to be resolved:

- What is the post mining value of alternative land uses;
- What are valuable and important habitats in the coal and oil shale regions and the ranges of existng and potential endangered species;
- What are the critical and limiting factors for these species;
- What are important interactions and synergistic effects between western energy development related to human activity and other factors that can produce major changes to significant ecological resources; and
- What are effective institutional mechanisms to effectively protect natural resources with identified special values?

Addressing these questions is greatly assisted by a systematic technical inventory of Western, Appalachian, Interior, and Gulf Coast ecosystems and a better evaluation of functional relationships between critical ecosystem components. The potential effects of population growth, minerals extraction, and other residuals from energy facilities and their requirements can then be more fully enforced.

Research programs to provide technical support include the needs identified for water quality and availability, and air quality. Technical data gaps can be identified in terms of: characterizing important technological processes, environmental characteristics, and developing theory and methodologies for predicting impacts. As indicated below, human behavior and institutional factors are important considerations in the assessment of changes to natural ecosystems from oil shale and coal gasification.

C.1 Technical Research

Profiles on the Utilization of Natural Environments by Workers. This data is essentially absent, yet critical for determinination of what appear to be major impacts from energy development: potential overutilization of existing valued environments. Research efforts need to focus on the patterns of human use of biological resources, including hunting, fishing, and other recreational activities in areas adjacent to intensive energy development. A small level of effort would be appropriate over the near-term.

Documentation of Vegetation and Animal Distribution. Emphasis should be on mapping critical habitat for endangered species. The establishment of importance or value of habitats used by a wide range of species, or that limit species abundance, such as identifying the extent and quality of riparian habitat adjacent to oil shale and major coal deposits should be a priority research need. (Several of the above needs are elements of current research, including the SEAM Program and the RIMAS Program [Resource and Inventory and Monitoring Program] of the

DOE.) A continuing level of effort at a moderate level of funding would be appropriate.

Effects of Habitat Fragmentation From Residential, Commercial, and Energy Development on Existing Ecosystems. A research program would require development of methods for measuring habitat fragmentation, as well as for comparing and assessing potential changes. A small to moderate level of effort over the near to mid-term would be appropriate.

C.2 Policy Research

Policy research for land use and ecological issues deals with the evaluation of alternative policies and potentially effective energy development programs. Combined effects of energy, agriculture, water, and rural assistance policies on the growth of towns adjacent to synfuel facilities and population needs to be assessed. Both energy and agricultural development are likely to expand in locations with extensive coal resources, and more intensified land use, habitat fragmentation, etc., is likely. Policies dealing with western energy land use need to recognize synergistic effects between policies to anticipate and effectively manage growth.

D. Health-Related Research Needs

Important questions that need to be resolved to evaluate health risks of oil shale and coal gasification include:

- What are the dose-exposure levels from energy facility residuals to susceptible receptor populations;
- What is the body burden to workers and to local residents from pollutants, including trace elements, trace organics, and radioactivity;
- How significant are surface and groundwater pathways to residual exposure;

- What are the major points or risk to the general public in terms of injury or accident; and
- What are the existing and potential problems and alternative solutions with the delivery of health care in the relatively isolated development sites?

D.1 Technical Research

Health research needs to focus on the potential scale and localized geographic scope of oil shale development in the West, and the unique physical, and demographic characteristics of western environment. Research on health effects for gasification facilities must incorporate wider geographic perspectives. In addition, an inventory of the current status of community health and health care delivery should be made to evaluate existing and potential health care and research priorities.

Specific program elements on technology and demographic characterization that could receive more emphasis to inform policymakers represents a continuing large scale program that includes:

- Residual characterization needs to emphasize trace elements and organic chemical segregation in discharge streams from facilities;
- Assessment of probabilities of failure, and residual release characteristics during start up, shut-down, and failure mode, and hazards exposures of workers and the general public during these events;
- Monitoring and systematic data collection of failure events, including a plan for information dissemination;
- Demographic data for areas where oil shale development and coal gasification is likely to expand. Important cultural and economic groups need to be specifically included, such as:
  - Indians, including a number of geographically and culturally distinct tribes;

- Western farmers and ranchers and counterparts in the East;
- Townspeople, including those in boomtowns (such as those associated with current development, or past developments such as old oil field boomtowns); and
- Construction and operation workforces.

• Epidemiological studies, including the current health status of such groups as identified above. A continuing large program model using appropriate important information should include:

- Existing levels of disease, including cancer, heart and respiratory diseases;
- Existing levels of health care, including an inventory of needs and demands, as well as an assessment of services provided.
- Ongoing epidemiological health and monitoring studies to document long term potential increases in disease incidence.

• Assessment of transport of pollutants to receptor populations, including a recognition, in the case of oil shale development, of western lifestyles; emphasis should be on both biological (food chains) and physical exposure pathways. A large-scale research effort over the long-term is needed. These transport processes should recognize different environments including:

- Meteorological characteristics;
- Unique hydrologic setting;
- Characteristics of the biological community;
- Agricultural setting and practices; and
- Social and economic characteristics.

• Physiological effects research now includes a wide spectrum of laboratory studies. A need exists for a more comprehensive use of epidemiological studies in western areas, especially boomtowns.

• Patterns of potential and bioaccumulation in coal and oil shale areas, including concentration of materials in

reservoirs, forests, and soils. A moderate to large scale effort is required that continues over the long-term.

D.3 Policy Research

An evaluation of present methods for exposure control, such as assessment of management and worker behavior in new energy facilities or to new mine environment standards is needed. In addition, current state and federal health care delivery policies in rural locations in identified potential synfuel facilities sites needs to be evaluated.

SUMMARY AND CONCLUSIONS

I want to conclude by indicating that the federal programs established from 1975 to 1981 were beginning to establish the framework for conducting R&D to resolve the health and environmental issues for synthetic fuels. In my testimony on October 1, 1981, I indicated specific research needs, some of which are also indicated in answers to your present questions. The estimates for additional funding levels summarized in Table 1 are above those included in the interagency energy R&D effort and those efforts within DOE, EPA, DOI, and other agencies. Rather than retrench those programs, they should be expanded to enhance the nations capability to assure timely and environmentally acceptable energy supplies for the coming decades.

TABLE 1: SUMMARY OF SCHEDULING AND COST ESTIMATES TO BE SELECTED RESEARCH AREAS

Area	Project Area	Cost[a]	Scheduling[a]
Water Quality and Availability	Water consumption data review	Moderate	Near- to mid-term
	Holding ponds discharge assessment	Moderate	Near-term
	Wastewater treatment systems	Moderate	Near-term
	Charactrizing water policy systems	Small to moderate	Near-term
	Documentation of existing allocations	Small to moderate	Near-term
	Quantification of Indian water rights	Small	Near- to mid-term
	Alternative institutional management of water use and pollution	Small	Near-term
Air Quality	Upset or Failure condition assessment	Moderate	Near- and mid-term
	Segregation of trace elements in energy facilities	Moderate	Near- and mid-term
	Comparison between naturally occurring and man-made sources (monitoring)	Moderate	Continuing
	Air Quality management among levels of government	Small	Near-term
	Public attitudes on air quality trade-offs	Small	Continuing
	Innovative air quality policies	Moderate	Near-term
Land and Ecologist	Profiles on the utilization of natural environments by workers	Small	Near-term
	Documentation of vegetation and animal distribution	Moderate	Continuing
	Effects of habitat fragementation	Small	Near- to mid-term
Health Related	Technology and demographic characterization	Large	Continuing
	Epidemiological studies	Large	Continuing
	Assessment transport to receptor population	Large	Long-term
	Patterns of bioaccumulation	Moderate to large	Long-term

[a]See introductory text for explanation.

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MITRE

December 10, 1981
W53-775

Congressman Don Fugua
Chairman, Subcommittee on Energy
Development and Applications
and
Congressman James H. Scheuer
Chairman, Subcommittee on National Resources,
Agriculture Research and Environment
Committee on Science and Technology
U.S. House of Representatives
Suite 2321 Rayburn House Office Building
Washington, D.C. 20515

Dear Chairmen:

Attached are my responses to the supplemental questions for the Hearing on Synthetic Fuels Environmental Research and Development which was held on October 1, 1981. The letter of transmittal was dated October 29, 1981.

The overriding theme which cuts across all of the responses as well as my testimony at the hearing is that synthetic fuels health, safety, and environmental research must be coordinated and integrated among agencies. In these times of fiscal constraint, no one agency has enough resources to compile all of the information needed to assure a timely and safe development of a synfuels industry. The research capabilities among relevant agencies must be pooled together in order to achieve a viable research program with an optimum expenditure of funds. This coordination would be a proper role for the Council on Environmental Quality. The Council also can see that the information produced is used efficiently in solving health and environmental problems. These oversight functions proposed for the Council are addressed by Recommendations 2, 3, and 4 of my oral testimony.

I thank the Subcommittees for the opportunity to present oral and written statements on this important topic. I will be glad to provide additional assistance to the Subcommittees in their preparation of initiatives in this area.

Sincerely,

Richard D. Brown

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Enclosure

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RESPONSES BY

RICHARD D. BROWN
DEPARTMENT STAFF
THE MITRE CORPORATION

TO SUPPLEMENTAL QUESTIONS FOR THE JOINT
HEARING ON SYNTHETIC FUELS ENVIRONMENTAL RESEARCH
AND DEVELOPMENT HELD ON OCTOBER 1,1981 BY THE
SUBCOMMITTEE ON ENERGY DEVELOPMENT
AND APPLICATIONS
AND THE
SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH
AND ENVIRONMENT
OF THE
COMMITTEE ON SCIENCE
AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

Date Requested
October 29, 1981

Date Submitted
December 10, 1981

PREFACE

This paper is submitted in response to four questions arising from the October 1 Hearing on Synthetic Fuels Environmental Research and Development. Of overriding importance, especially in these times of fiscal constraint, is the coordination of synthetic fuels health and environmental research conducted by different agencies. This coordination could be provided by the Council on Environmental Quality. The Council can link research efforts to the information and timing needs of domestic energy development and can ensure that the agencies are jointly conducting an adequate and viable research program without duplication of effort. The Council also can oversee the clearinghouse functions identified in Recommendation 3 of my oral testimony.

This paper reflects the opinions of Richard D. Brown. It does not necessarily reflect the views and policies of The MITRE Corporation.

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QUESTION 1. MONITORING

"You state that monitoring is a last-ditch activity and that the real answer lies in control technology. How do you propose to establish effective controls in the absence of comprehensive monitoring?"

My choice of words may have been unfortunate. The point I hoped to make was that monitoring alone cannot control pollution. Naturally, however, comprehensive monitoring is necessary to determine the effectiveness of pollution control devices and practices, especially with regard to unregulated pollutants. In fact, effective monitoring will ultimately provide the key to developing pollution control regulations for the fledgling synfuels industry.

As yet there are no pollution control regulations that specifically concern synfuel facilities. It would not be proper to draft such regulations until we fully understand what pollutants will be emitted by these future facilities and how they should be regulated. That understanding can only come through monitoring, after synfuel facilities actually begin operating.

Initially, synfuel operations will probably utilize control measures that are employed by the similar petroleum and petrochemicals industries. Through source and ambient monitoring, we can then ascertain whether such state-of-the-art pollution control devices are sufficient to limit the full range of potential synfuel pollutants that may pose a substantial threat to human health and the environment.

The commercial synfuel facilities which are under development will require air and water operating permits. These can be issued for a short period of time, perhaps 2 to 3 years. During this period of operation, monitoring data can be collected and evaluated to determine if more stringent pollution controls should be required before the permits are renewed.

The initial permit can be issued on the condition that comprehensive monitoring be conducted. However, as noted in Recommendation 1 of my oral testimony, Congress will need to mandate the monitoring of unregulated pollutants. Moreover, I propose that the U.S. Environmental Protection Agency (EPA) be given oversight responsibilities for collecting the data and making it available for public scrutiny. The data can be of high quality, particularly if it is collected through EPA's quality assurance program.

QUESTION 2. RESEARCH AND DEVELOPMENT

"Please provide your opinions on the R&D programs needed to define any health and safety problems in the synthetic fuels industry and how they can be integrated with process development activities. Cost and scheduling information would also be appreciated. Specifically we would especially like your views on how this could be done for coal gasification technology and both surface and MIS oil shale retorting."

Summary

Since the Department of Energy has terminated development of large-scale synfuel demonstration facilities, the Department's health and environmental research program will have limited access to process samples. The success of the research program will depend upon the availability of representative process samples for testing. The availability of such samples could be assured through contracts negotiated by the Synthetic Fuels Corporation with sponsors of commercial scale facilities. These contracts should provide for access to process and waste streams to measure, and acquire samples and occupational health related data.

Research needs for aboveground and subsurface oil shale retorting and for coal gasification are well documented. The priorities, timing, and estimates of resources for this research, expressed in person-years, are contained within the report entitled "Health and Environmental Effects of Synthetic Fuel Technologies: Research Priorities," which has been entered into the record as an appendix to my oral and written statements.

It is vitally important that the Federal Government maintain a commitment to sustaining a viable health, safety, and environmental research program. To ensure that available funds are applied to the most important problems without wasteful duplication of effort, research activities among agencies must be coordinated and integrated. This specific need is addressed by Recommendations 2, 3, and 4 in my oral and written statements entered into the October 1 hearing record.

Effects Research

Generic synfuels research is important to our ability to understand basic health and environmental problems associated with the conversion of coal and oil shale into synthetic fuels. This research provides predictive capabilites regarding health and environmental effects across technologies and largely addresses problems associated with the conversion process, irrespective of specific technologies. A generic research program recognizes that it is not necessary to replicate effects research on each technology. A large amount of information is applicable to all technologies.

Together with region-specific research and process-specific research, generic studies have been integrated into a comprehensive DOE-sponsored program of applied synfuels research. The program, initiated by the Energy Research and Development Administration (ERDA), has a considerable history of achievements in amassing health and ecological information relevant to impacts attributed to conventional and advanced energy technologies.

An example of an achievement of the DOE program was highlighted in the oral testimony presented by Drs. Michael Massey and Michael Chartock, and discussed among Committee members at the October 1 hearing. The topic was the control of unregulated pollutants, particularly primary aromatic amines. DOE research has determined that these compounds, found in coal liquids, are highly active mutagens and that there are options for the management of these toxic substances. The options include hydrotreating all or a portion of the product; using the high-boiling-point fraction of the product (portion of product containing most of the mutagenic/carcinogenic activity) for gasification, and using the high-boiling-point fraction as plant fuel.

A sustained commitment to the maintenance of the DOE synfuels program is critical. Many questions concerning health and environmental impacts will not be answered without this program. Whereas industrial health-related research generally is structured within a 2-year timeframe and directed to regulatory issues, the DOE

program looks ahead at chronic effects problems and problems which may not materialize for several years (at a time when the effects may be irreversible).

Of particular importance is the need to support inhalation toxicology. This research, which involves whole animal testing, is expensive and is not being adequately funded. This research is necessary to adequately address the concerns expressed in Committee testimony on October 1 concerning the effects of worker exposure to toxic air pollutants.

Risk Assessment

The assessment of risk is a crucial consideration with regard to the synthetic fuels industry. The Federal Government should play an important role in identifying and quantifying potential health hazards associated with various development options. This would allow the government to provide guidance in the choice of control technologies and process modifications in order to optimize the use of economic and resource factors without adversely affecting human health and the environment.

Toward this end, EPA has begun a quantitative assessment of health and environmental risks posed by synfuel facilities, similar to that conducted for nuclear power.* The study identifies pollutant release rates (source terms), assesses pollutant exposures as well as health and environmental effects, and analyzes health risks for a typical plant site. Environmental effects are assessed in terms of economic loss (e.g., crops and fishery resources), loss of species and habitat, and other ecosystem changes. It is important that this program receive adequate and sustained funding to complete its objectives.

A critical supporting study which must be implemented soon is the testing of a complex terrain air quality model in the Green River

*Risks associated with nuclear power were analyzed in An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants, informally known as the Rasmussen Report)

Basin of Wyoming. If validated, it will improve our understanding of the potential impacts of long distance transport of air pollutants from the concentrated development of synfuels in western localities.

The DOE also has an important risk assessment program, but its focus is on the overall national health and environmental risks associated with installing and decommissioning a synfuels industry. The program furnishes DOE with guidance in setting research priorities.

Industrial Hygiene

During FY 1982, the National Institute for Occupational Safety and Health's synfuels research program will be virtually eliminated with a termination of funds from the Energy/Environment Research and Development Program (a pass-through program administered by EPA). This will result in termination of Federal research directed toward understanding and solving the health problems faced by workers in synfuel facilities. Studies are needed to: (1) identify routine and accidental worker exposures to toxic substances; (2) develop instruments to measure pollutants within the workplace environment; (3) develop clothing, respirators, decontamination procedures, and other methods to protect workers from toxic substances; (4) develop criteria for medical examinations and training programs; and (5) initiate prospective epidemiological data bases.

Access to Facilities

Synthetic Fuels Corporation (SFC) contracts must permit access to project sites for research purposes. Such access is critical to collect process and waste stream samples as well as epidemiological data. The SFC assisted projects offer an opportunity for government research programs to obtain data that will be useful in answering questions related to the development of coal and oil shale resources, processes, and pollution control strategies.

QUESTION 3. TOXICOLOGY AND EPIDEMIOLOGY

"You recommend four actions involving synthetic fuels plant monitoring, research data review and dissemination, and agency coordination. You omit toxicology and epidemiology programs. Please comment on these omissions."

These high priority areas are discussed on pages 12 and 13 of my written submission. Details are provided in the report, "Health and Environmental Effects of Synthetic Fuel Technologies: Research Priorities," which was provided to the Subcommittee as an appendix to my written statement.

In my oral testimony, I indicated that the Department of Health and Human Services would be a necessary member of the proposed task force on coordinated research. I elaborated on this in my response to Representative Schneider's question concerning my emphasis on the need for worker exposure and morbidity studies. In response to the question, I indicated that such studies were necessary before regulations concerning occupational health could be adequately formulated and that funds necessary to conduct such studies should be allocated to the National Institute for Occupational Safety and Health and the National Institute of Environmental Health Sciences. Funding in these areas has essentially been terminated due to cutbacks in EPA's "energy pass-through" research program.

QUESTION 4. POLLUTION CONTROLS

"What control technologies or process refinements need to be developed for synthetic fuels and what information is needed to guide such development?"

Discussion

Pollution abatement strategies for synthetic fuel facilities will depend on the specific site, feedstock, end-product mix, environmental considerations, and resource constraints. Available control devices have been developed for use at petroleum, petrochemical, coke and power, and synfuel pilot facilities.

In controlling air pollution, applicable technologies are: (1) wet and dry flue-gas desulfurization (both regenerable and nonregenerable) for the control of sulfur oxides; (2) cyclone separation, wet scrubbing, electrostatic precipitation (ESP), and baghouse filtering for the control of particulate matter; (3) combustion modification and flue-gas denitrification for the control of nitrogen oxides; (4) physical, chemical, and dry-bed absorption of acidic gases; (5) Claus and Stretford sulfur recovery techniques for the control of hydrogen sulfide from acid-gas-treatment processes; and (6) absorption, condensation, and incineration for the control of hydrocarbon vapors.

Wastewater treatment technologies include gravity separation, steam stripping of ammonia, solvent extraction of phenols, biological and wet-air oxidation, filtration, carbon adsorption, desalination, ion exchange, and incineration. The processes of ammonia stripping, phenol extraction, ion exchange, and desalination can yield saleable by-products.

These conventional options for control technology emphasize an "engineering fix," or an expedient way to lessen pollutants generated from existing plants. Such an approach need not be taken, however, with the construction of new large-scale synfuel facilities. This emerging industry can incorporate environmentally sound processes and techniques into plant designs. Such techniques can be integrated into specific feedstock handling and fractionation processes at various product processing and refinement stages.

A major concern with respect to air pollution and worker health relates to the release of potentially toxic fugitive emissions from leakage and evaporation from pumps, valves, flanges, and drains. Control equipment is available for fugitive emissions and is beginning to be employed in modern petroleum and petrochemical

facilities. Controls for various sources include double mechanical seals with fluid barriers (for pump and compressor seals); directed frequent and diligent maintenance (for valve packings); o-ring compression seals (for flanges); and double-valved sampling ports for drains. A well designed maintenance program focused on the early identification and elimination of fugitive emission sources is needed at each large synfuel facility. Such a program should include equipment inspection, leak detection, and area monitoring protocols.

It appears that state-of-the-art technologies can be used to control air related criteria pollutants and conventional water pollutants (i.e., suspended solids, oil and grease, oxygen demanding materials, waste heat). However, members of the public and the scientific community are concerned that unregulated pollutants, many of which are considered to be toxic,* may not be adequately controlled by existing technology. Many of these unregulated emissions are fugitive in nature. The only facilities required to control these emissions may be the relatively few receiving assistance under the Energy Security Act (PL 96-294). Section 100 recognizes that synthetic fuels development in a manner consistent with the protection of the environment will require financial commitments beyond those expected to be forthcoming from nongovernmental capital sources and existing government incentives.

Research and Information Needs

Process Modification

Process modifications can greatly reduce the likelihood of uncontrolled emissions being released into the workplace and the ambient environment. We have seen, for example, the vast improvements that have taken place in synfuel technologies. In Germany during World War II and in the U.S. in the last decade, liquefied coal was separated from mineral matter by filtration. The high temperatures and pressures used in this process caused a high rate of leakage, exposing operators and maintenance personnel to

*See oral and written testimony concerning pollutant monitoring for specifics.

toxic solvent vapors and carcinogenic tars.* The current synfuel technologies of Solvent Refined Coal-II, H-Coal, and Exxon Donor Solvent have replaced filtration with distillation as a means of solid-liquid separation. This results in far less equipment breakdown and is less likely to result in worker exposure to harmful substances.

This is a fruitful area of research which can lead to improved process efficiency and reduced costs, as well as improved pollution control. Such research would be best conducted by industry (e.g., industry sponsored research and development institutes). Incentives for such research can be provided by direct financial subsidies or tax credits. The agency most familiar with such co-sponsored research and which can provide oversight is the EPA. Impetus for Federal involvement in this area can be provided and mandated by means of an appropriation act.

Fugitive Emissions

Protocols need to be developed for the components of a responsive synfuels maintenance program directed toward controlling fugitive emissions. These need to address standard procedures for equipment inspection, leak detection, and workplace emissions sampling. This research would be a natural outgrowth of the EPA control technology development activities associated with petroleum refining and storage.

*Evans, James M. 1980. "The Chemical Engineers' Role in Health Protection." Presented at the International Seminar of the Commission of the European Communities Assessment of Toxic Agents at the Workplaces--Roles of Ambient and Biological Monitoring, Luxembourg, December 8-12.

Mr. SCHEUER. The meeting is adjourned, subject to call of the Chair.

[Whereupon, at 4:05 p.m., the subcommittee recessed, to reconvene subject to call of the Chair.]

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